Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXIX. NEW YORK, SATURDAY, MAY 17, 1902. No. 20.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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ELECTRICAL WORLD AND ENGINEER.

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Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Single Copies, - .10

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Entered as second-class mail matter at the New York Post Office.

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THE CONVENTION.

The meeting in Cincinnati, next week, of the National Electric Light Association not only brings to a natural close one term in the existence of that body, but its results are likely to have no small effect in determining its future. The indications are quite hopeful, for the association has rarely, if ever, had so good a programme laid out for it, or so many good papers prepared. It now remains to see what the attendance is, and how thoroughly the papers and topical questions are discussed. We venture to believe that an excellent showing will be made, and that the association will gather up both new strength and new members. There are many opportunities for good work awaiting it, and the growth of the electric light and power industry will certainly bring it many more as new problems come up for settlement.. The association has never yet lived up to its ideals, because those ideals are constantly advancing, and it can to-day set its standard of achievement higher than ever. We trust Mr. Doherty will feel rewarded for the hard work he has been doing as president, by the record of the coming week in Cincinnati; and if any of our readers who should be there have not yet started, we can only urge upon them to attend and lend their best aid and support to the association which represents their interests.

THE FAREWELL TO LORD KELVIN.

It was an altogether happy impulse which prompted Mr. Anthony N. Brady to give a dinner in honor of Lord and Lady Kelvin last week, prior to their sailing for England. A trip which began with a notable reception by the scientific electrical engineering element was thus rounded out with the hearty farewell good wishes of those who are handling the largest electrical plants in the world—for lighting, transportation, telephony, etc.—men glad to be able to welcome as one of themselves the great physicist, who, beginning his inventive career as a submarine cable engineer some fifty years ago, is in full touch with, and has keen appreciation of all the later practical applications and developments. It is, indeed, this freshness of mind and ready grasp of what is now being done that has impressed all who have met Lord Kelvin this time, after so rich and rounded a life of public service; and his felicitous utterances at the banquet last Thursday have naturally made quite an impression, as evidenced by the daily newspapers. No better augury as to the future of our great electrical industries could be asked than this evident desire of the leaders in them to do honor to the other leaders from whom the fundamental, underlying ideas must come upon which such arts must be founded. It was a pleasant thing, also, that Edison, Sprague and Tesla were all able to be present on so interesting and memorable an occasion.

DEMAND SYSTEMS OF CHARGING.

A recent editorial of ours has stirred a most esteemed correspondent to a vigorous defense of the Wright demand system. Now, we have nothing against this or any other system of charging, and are very far from holding a brief for the flat rate, but we must recognize the fact that the authorities generally, and particularly a body with the plenary powers of the Gas and Electric Light Commissioners of Massachusetts, have the last word in the debate. A very specious argument might be put up to show the inherent and eternal propriety of making a

customer's rate directly proportional to the square of his distance from the station, or a function of the load curve expressed in polar coördinates, or any one of half a dozen other things which bear on the cost of service. But business men have to adopt broad business methods and charge up to profit and loss many things that the bookkeeper might wish were otherwise disposed of. What would happen to a dry goods store that charged against each purchase the cost of the salesman's time in showing the goods? There would be an element of essential justice in the proposition, but customers would go elsewhere, and if stores united to enforce the rule we should see the most hair-raising anti-trust statutes yet enacted.

So it is in the electrical business. Corporations which can do business at all only in virtue of a public franchise have to walk Spanish in many particulars, and their methods in the long run must meet the requirements of the general public if they are to succeed. We therefore find a strong tendency to adopt broad and liberal business methods to encourage the general and liberal use of the product, and to meet the public more than half way. Within limits, a demand system of charging may be, and has been, applied with an advantage to all concerned. But the moment it is so applied as to conflict with the broader interests of the community there is liable to be trouble. A lighting company does not merely deal with its customers personally, like a grocery store, but it deals with them as members of a corporate community on which it confers and to which it owes benefits. A recognition of these reciprocal obligations is the keynote of success. If, as our correspondent indicates, the application of a particular method of charging makes the price of electrical energy prohibitive to any considerable number of customers, these will certainly, as members of a franchise-granting community, demand a new deal in no uncertain terms. It will be no defense to allege that a loss can be figured out on these customers, for in most fundamental relations a public service company is dealing with the community as a whole, and not merely with individual members of it. Hence the existence of commissions and similar bodies, with power to regulate rates. There are those who deny on ethical grounds the propriety of such regulation, but that question is neither here nor there, for they exist, and are sometimes unpleasantly active. The question of charging methods is, therefore, like the larger question of rates, a thing that sooner or later has to be settled with the representatives of the community. Its demands are sometimes reasonable, and sometimes quite otherwise, but it has the ultimate power of enforcing them. Any method of charging, therefore, by maximum demand, or otherwise, must meet general as well as special requirements, else it will come to grief. The Woburn plan is being tried by this touchstone, and will be judged, fairly, we hope, by its practical results. We should be extremely gratified at the acceptance on the part of the public of the principle of the demand system, for no one can deny its equities. On the other hand, there is a danger that its forcible application may in instances give rise to a situation not at all to the interest of a public service corporation.

Electric Cables.

In the February number of the Bulletin of the Société Internationale des Electriciens, appears an interesting discussion upon the subject of the tests and specifications for electric cables, an abstract of which recently appeared in the Digest. A committee of the society appears to have sent a circular letter of inquiry to a number of cable manufacturers and experts, eliciting their views on the subject. The main results of the inquiry are speedily summarized. They recommend a volt-resistance test of 100 per cent. pressure over and above that of full normal load, if the test is applied before laying, and 25 per cent. extra pressure after laying. Ohmic insulation is very properly relegated to a subsidiary position, but for subsidiary use, kilometric insulations are recommended on the following sliding scale; 700 megohms for cables up to 1 kilovolt, normal working pressure; 3,000 megohms up to 4 kilovolts, and 6,000 megohms up to 10 kilovolts. Just why these particular numbers were selected it is hard to discover. They suggest, to some extent, in a profane mind, the numbers that come to light in the Book of Revelations. To the ordinary mind, seven hundred megohms-kilometres per kilovolt would appear sufficient to cover the premises. Concerning tastes, however, *non est disputandum.* M. Grosselin, in discussing the outcome of the correspondence, criticises this sliding scale, and, in our opinion, justifiably. He suggests that five hundred megohm-miles would be sufficient for all pressures of normal operation. In general, it would be better to secure reliable means for preventing the occurrence of abnormal rise of pressure in a cable, than to spend much money upon so great a thickness of insulation as would withstand all the rise of pressure that could ever occur in it unchecked.

Practical Transformer Testing.

The desirability of testing all transformers before putting them into service has been so long sounded in the ears of central station men by convention papers and in other ways, that further argument or urging upon that point would seem to be unnecessary. The large central stations now all do this, and the smaller ones which are considering it care more to know of practical methods for performing this testing in a rapid and sufficiently accurate manner, than to have discussed the abstract question of the desirability of such testing. Indeed, upon the simplicity and commercial practicability of the actual testing methods available will depend the central station man's decision on whether or not to test all transformers purchased. It is just this kind of practical detailed information that is given in an article by Mr. R. F. Schuchardt, of Chicago, in another column. Mr. Schuchardt's connection with the testing department of one of the largest central station companies in the country gives this article the authority of one who comes in daily contact with this class of work, and who, consequently, is in an excellent position to know the practical requirements and the "short cuts" that are possible without seriously interfering with accuracy. It is one thing to know the theory of testing and quite another to evolve by long practical experience methods not too cumbersome for rapid daily use.

It goes without saying that not every small central station can afford a testing apparatus as elaborate as that described, nor the experts to work it, but there are few, indeed, that cannot make part of the tests, and it is not essential in the smaller plants to analyze the total losses in any transformer to the extent outlined by Mr. Schuchardt. The tests for regulation and core loss or voltage drop between no load and full, and watts lost in "leakage" or magnetizing current, are the most essential and also, fortunately, with modern instruments, the most easily made. For these two tests a good portable indicating wattmeter and a voltmeter, of range adapted to the secondary circuit, are all that is necessary, and these are instruments that have plenty of other uses around small central stations. We do not wish to be for a minute understood as considering the methods outlined by Mr. Schuchardt as too elaborate for the larger companies, but on the other hand, the smaller companies should not be discouraged through insistance on tests as extensive as are made by the large stations.

One sentence in the article referred to might well be put in larger type for emphasis. It is that calling attention to the importance of

keeping instruments accurately calibrated. Very few men outside of those on the technical side of the electrical instrument business seem to have any conception of the importance of frequent comparison of portable instruments with standards and the liability of instruments to get out of calibration. A feature of this paper, which will interest many, is the table of average results obtained from transformers of the best modern manufacture. Representing as they do, the results of hundreds of tests rather than a test on one or two samples, and tests made by unprejudiced engineers, the figures given deserve a permanent place of more than ordinary prominence in transformer engineering data.

THE FIELD OF FORCE IN WIRELESS TELEGRAPHY.

It is both curious and entertaining to observe the various and opposing theories concerning the *modus operandi* of wireless telegraphy which are, or until very recently have been, in vogue among practical electricians. Some of these are discussed in Mr. de Forest's article published in this number. Of course, many details concerning the action and propagation of these waves are far from clear, and will require elucidation in the light of future experimental research; but there can be no reasonable doubt, at this time, that the action is propagated in the space above the earth, or, popularly speaking, in the air. In so far as the action is conducted below the surface of the earth it is prejudicial.

In the case of an insulated aerial telegraph wire employing ground return, it is well known that the waves which run over its surface terminate on the ground perpendicularly, if that surface is electrically conducting; and that the field of force in that case is just as though the earth were removed from beneath the wire and a parallel return wire substituted at a distance vertically beneath the original wire of twice its original height above the surface. The assumed perfectly conducting surface is then coincident with the natural zero equipotential surface midway between the real wire and its "image." As a matter of fact, however, the earth's surface is never perfectly conducting, and consequently the hypothetically resulting field of force is automatically modified to meet the actual condition. Strictly speaking, therefore, the electrostatic capacity of an aerial telegraph wire must vary, for a given elevation above ground, with the conductivity of the soil, being greater in moist weather, or over the surface of salt water, than in dry weather, or over the surface of non-conducting rock. As a rule, however, the insulation of aerial wires is not sufficiently high to enable this difference in capacity to be observed experimentally.

In a similar manner each vertical antenna of a wireless telegraph system, when grounded at its base, is virtually united to an image antenna, of the same length, hung vertically below it and with the earth removed. The real antenna with its image beneath, would permit of one complete vibration in the time during which the charge made one complete to-and-fro motion, or had run both up and down the two antennæ, or over four times the length of the real antenna. This is why the length of the real antenna is always approximately one-fourth of the wave length of the emitted wave. A fifty-metre antenna (164 feet), grounded at its base, emits waves two hundred metres long, or having a frequency of one and one-half millions of cycles per second. The field of force of the emitted waves, with the earth assumed perfectly conducting, is always to be found by considering the Hertz oscillator, formed of the antenna and its image, plotting the waves in tri-dimensional space, and then ignoring all below the mid-level-plane bisecting the system through the junction of the real and image antennæ, which plane is coincident with the conducting earth's surface.

Just as in the wire-telegraph case, the field of force of wireless expanding waves is modified by the fact that the earth's surface is neither quite level nor perfectly conducting. In so far as the curvature of the earth is concerned, the waves follow it or conform to it, just as they conform to the surface of a wire in wire-telegraphy. It is not more wonderful that wireless waves bend slowly to a radius of about 6000 kilometers than that wire-led waves in ordinary telegraphy turn a sharp corner when the wire is bent suddenly, as at a street crossing. In so far as concerns the imperfect conductivity of the earth, the field of force is modified, because the waves, instead of being completely reflected at the earth's surface, are only partly reflected, and the remainder penetrate into the earth, until, after having traversed a number of strata in succession, nearly all the wave energy is reflected and practically none is left to sink deeper. Now all the energy that is reflected from the top surface is thrown back into the ether, or air, and aids or intensifies the advancing wave in the air; but the deeper the layer at which reflection occurs, the less the chance of the reflected energy emerging above the ground to swell the air-wave, for the energy ascending through the ground tends again to be reflected downwards, or in the wrong direction. The energy which sinks into the ground tends, therefore, to be scattered and absorbed as heat, to the loss of the advancing air-wave. It is easy to see, therefore, why an ocean-surface is so much better to telegraph wirelessly over than an ordinary moist land-surface, and this, in turn, than a dry or desert-land-surface. It is conceivable that a very intense and powerful Hertz oscillator of the vertical type, *i. e.*, a grounded antenna, might be used to diffuse warmth into the ground below the immediate surface, around the antenna, for some particular purpose, in which it was desired to raise the temperature of the soil by indirect electromagnetic energy, as distinguished from the sun's rays. In such a hypothetical scheme the usefully acting radiation would be that part which for wireless telegraphy we call useless or wasteful, or the part expended in the ground.

We are in doubt as to whether the mid-day difficulties in wireless signalling to which Mr. de Forest refers are due to any change in conductivity of the air, or alteration of the field of force. In the absence of conclusive evidence, we incline to think that the difficulty referred to lies in the coherer, as affected by feeble atmospheric discharges at these times of day, and that if the coherer could be operated at all times with equal sensitiveness and freedom from atmospheric disturbance, the signalling would be continuously maintained. It is evident that good ground to a wire telegraphist means any good connection to a stratum of conducting soil, however deep, and that the surface of the ground may be non-conducting if the wire telegraphists can reach a deeper conducting layer. On the other hand, good ground to a wireless telegraphist means a good conducting surface or top soil (to a frequency of a few millions of cycles per second), and deep-seated good conductivity is not nearly as good as superficial good conductivity. Curiously enough, the e.m.f. which actuates the coherer, or receiving wave-detector, is similar to that developed in a dynamo with stationary armature and moving magnetic field. The magnetic field of wireless telegraphy extends in expanding rings concentric to the sending antenna, and these horizontal circular lines of force, on reaching the radius of the receiving station, "cut" the receiving antenna, and induce the sudden impulse of e.m.f. in it that influences and actuates the coherer.

N. E. L. A. Convention Programme.

The programme for the convention of the National Electric Light Association, at Cincinnati, next week, has been provisionally arranged as follows by President Doherty, who will give an opening address at 10 A. M., on Tuesday. The papers will then come in the subjoined order as nearly as possible, with a "question box" period in each session:

"Does It Pay to Treat Poles With Creosote, Oil or Other Compounds," W. E. Moore, Augusta, Ga. "Performance of the Present 220-Volt Lamp," Fred W. C. Bailey, Columbus, Ohio. Report of Committee on Standard Rules for Electrical Construction and Operation. Afternoon session, 2 o'clock—"Three-Phase vs. Two-Phase for City Distribution," B. A. Behrend, Cincinnati; Chas. F. Scott, Pittsburg. "Protection of Long-Distance Telephone Transmission Lines," F. A. C. Perrine, Pittsfield, Mass.; L. Denis, Quebec; P. N. Nunn, Provo, Utah; P. M. Lincoln, Niagara Falls, N. Y.; H. G. Gille, St. Paul, Minn. "Boiler Firing with Oil," Jas. W. Warren, Los Angeles, Calif.; H. T. Edgar, El Paso, Texas. Report of Committee on Legislation Regarding Theft of Current.

Wednesday, May 21, 1902, morning session, 10 o'clock—"The Advantages of Gas Engines," Chas. H. Williams, Madison, Wis. "Are Free Lamp Renewals Desirable?" James English, New Haven, Conn.; F. Ellwood Smith, Somerville, Mass.; F. W. Little, Peoria, Ill.; W. J. Greene, Cedar Rapids, Iowa. "Hot Water vs. Steam Heating," J. F. Porter, Alton, Ill.; P. H. Korst, Janesville, Wis.; C. R. Maunsell, Topeka, Kan.; D. F. McGee, Red Oak, Iowa. Report of Committee on Analysis of Flue Gases. Report of Committee on Uniform Accounting. Afternoon session, 2:30 o'clock—"What Efficiency Lamp Should be Used?" Henry L. Doherty, Samuel E. Doane, Marlborough, Mass.; L. G. Van Ness, Denver; Francis W. Willcox, Harrison, N. J. Report of Committee on Photometric Values of Arc Lamps, Henry L. Doherty, chairman. Report of Committee on Standard Candle Power of Incandescent Lamps. Evening session, 8 o'clock—"Display Lighting, Signs and Decorations," Russell Spaulding, New York. "Possibilities of Sign and Decorative Lighting," E. J. McAllister, Newark, N. J.

Thursday, May 22, 1902, morning session, 10 o'clock—"Rates," Henry L. Doherty, Denver; L. A. Ferguson, Chicago; Alex. Dow, Detroit; L. R. Wallis, Woburn, Mass.; Ralph J. Patterson, Waterville, Me.; Samuel, Scovil, Cleveland, Ohio. "What Improvement is Desired in Meters?" Robert Ferris, Monmouth, Ill.; C. A. White, Somerville, Mass.; H. H. Scott, Lincoln, Neb. Report of Committee on Amendments to Freight Classification. Afternoon Session, 2:30 o'clock—"Are Loose-Leaf Ledgers Desirable for Electric Companies' Records?" G. E. Tripp, Boston, H. H. Fairbanks, Worcester, Mass.; Geo. W. Davenport, Boston; Charles R. Price, New Bedford, Mass. "What Changes Should Be Made in the Plan of Uniform Accounting?" J. P. Crowley, St. Paul, Minn. "Caring for Consumers' Complaints," Irvin Butterworth, Denver. Executive session—Reports: Secretary and Treasurer; Executive Committee; Committee on Amendments to By-Laws; Committee on Legislative Policy; Election of Officers; Committee on Finance.

Electrical Engineers of the Day—XLVI.

WALTER S. MOODY.

Walter Sherman Moody was born in Chelsea, Mass., a suburb of Boston, in 1864. After the completion of his studies in the public schools of his native city, he entered the Massachusetts Institute of Technology in 1883, finishing his course in electrical engineering in 1887, after which he was immediately made an instructor in the laboratories of Physics and Electricity at that institution. Not wishing to make teaching a profession, Mr. Moody resigned his position in June, 1888, to accept an offer from the Thomson Electric Welding Company, of Lynn, Mass., which had just been organized to develop commercially the electric heating and welding of metals under patents of Prof. Elihu Thomson.

The knowledge gained during the four years in which Mr. Moody was assistant engineer with the welding company was of exceptional value compared with any equal period in his fourteen years' experience as an electrical designer. In connection with the handling of currents of extremely small pressures but enormous volumes, sometimes exceeding 100,000 amperes, self-induction first became a commercial obstacle outside of the arts of telegraphy and telephony, and to counteract this all apparatus for welding had to be designed for a frequency much lower than that prevailing at the time, which was 125 cycles or higher.

At the end of about four years' service with the welding company Mr. Moody resigned his position to enter the engineering department of the Thomson-Houston Company, and for the first few months was engaged in the design of direct-current machines, but soon returned to more congenial work on alternating-current apparatus.

For the past eight years most of Mr. Moody's time has been devoted to the design and manufacture of the great number and variety of transformers built in his department, although a great diversity of alternating-current apparatus, such as feeder regulators, reactive coils, condensers, fan motors, etc., come under his charge. There have been manufactured under Mr. Moody's direction up to the present time nearly 200,000 transformers, including over 3,500 designs, the present rate of production being about 280,000 kilowatts per annum. The introduction into America of the "core" type of transformer was due to Mr. Moody, and his name is inseparably associated with the development of the now widely known

"H" transformer, as manufactured by the General Electric Company.

The "air-blast" type of transformer was also first developed by Mr. Moody. There are in use at present over 300,000 kilowatts of such transformers built to Mr. Moody's designs, some operating at as high as 35,000 volts, and including among others such plants as the Niagara & Buffalo transmission, Metropolitan Railway Company of New York City, Central London Railway, Southern California system and Cauvery transmission, India.

Numerous suggestions have been made to build transformers with hollow conductors, the idea probably originating with Prof. Rowland several years ago, but Mr. Moody is the pioneer in reducing the same to practice. As a result, many such transformers are now in use where large units with low-working voltages for electrolytic work are required. Transformers of this description have been made in capacities ranging from 750 to 2,200 kilowatts, and are employed in the manufacture of carbide of calcium, carborundum, graphite, and aluminum.

Much of Mr. Moody's success in life is but the natural outcome of exceptional capacity for organization and the control of men, coupled with a broad and general business knowledge and a clear and comprehensive understanding of engineering problems, from the design of apparatus to its subsequent use. Moreover, he is an indefatigable and enthusiastic worker, and possesses in a marked degree that personal magnetism which arouses in those in his service a spirit of emulation that brings forth their best efforts in his behalf.

The Cincinnati Gas and Electric Company

VISITORS to the National Electric Light Convention of 1902, at Cincinnati, will find the electric light central station work of that city undergoing a great change. The present time marks a transition period in the electric light station work in Cincinnati. For a number of years previous to 1901 there were in Cincinnati three electric light companies controlled by the Cincinnati Gas Light and Coke Company besides the Cincinnati Edison Electric Company. The three companies controlled by the Cincinnati Gas Light and Coke Company were the Jones Brothers Electric Company, the Brush Electric Light Company and the First Cincinnati Edison Illuminating Company. The war between these three allied companies controlled by the gas interests on the one hand, and the Cincinnati Edison Electric Light Company on the other, waged hot for several years. Indeed, it is doubtful if a more fierce competition in the electric light business has taken place in any large city in the United States in recent years.

After several years of this war, in which rates were cut indiscriminately and a great tangle of pole lines run over the city, a consolidation was effected early in the year 1901, by which all the electric light central station companies and the gas company were merged into the Cincinnati Gas and Electric Company.

The officers of the Cincinnati Gas and Electric Company are: General A. Hickenlooper, president; Norman G. Kenan, first vice-president; C. W. Wetmore, second vice-president; Henry W. Sage, secretary; Charles J. Foust, treasurer.

The electrical department has as its general superintendent, H. C. Hutchinson, with Charles Jones, superintendent of stations, and H. J. Pfiester, superintendent of electrical distribution. These gentlemen have before them no small task. In place of supplying energy from four different central stations, three of which are out of date, everything is to be changed over for supply from one central generating plant. This central generating plant will be the one formerly used by the Cincinnati Edison Electric Company, but very much enlarged in capacity and changed in various details to be described later. At the present time, in Cincinnati there is an immense net-work of wires overhead in the down-town district. The old Edison three-wire net-work was, of course, underground, but everything else was overhead.

A most important change now being made is the putting underground of all the wires within a certain district in the down-town portion of the city. The territory covered by the company's lines, both overhead and underground, can be seen from the accompanying outline map, Fig. 6. This territory is roughly 43 square miles. The greatest distance from the power house, from which current is supplied, is eight miles. The underground district recently established is irregular in shape, about 6,000 feet long by 3,200 feet wide. The main power house, from which all current is to be supplied, and which is now furnishing the largest part, is at Plum and Charles Streets.

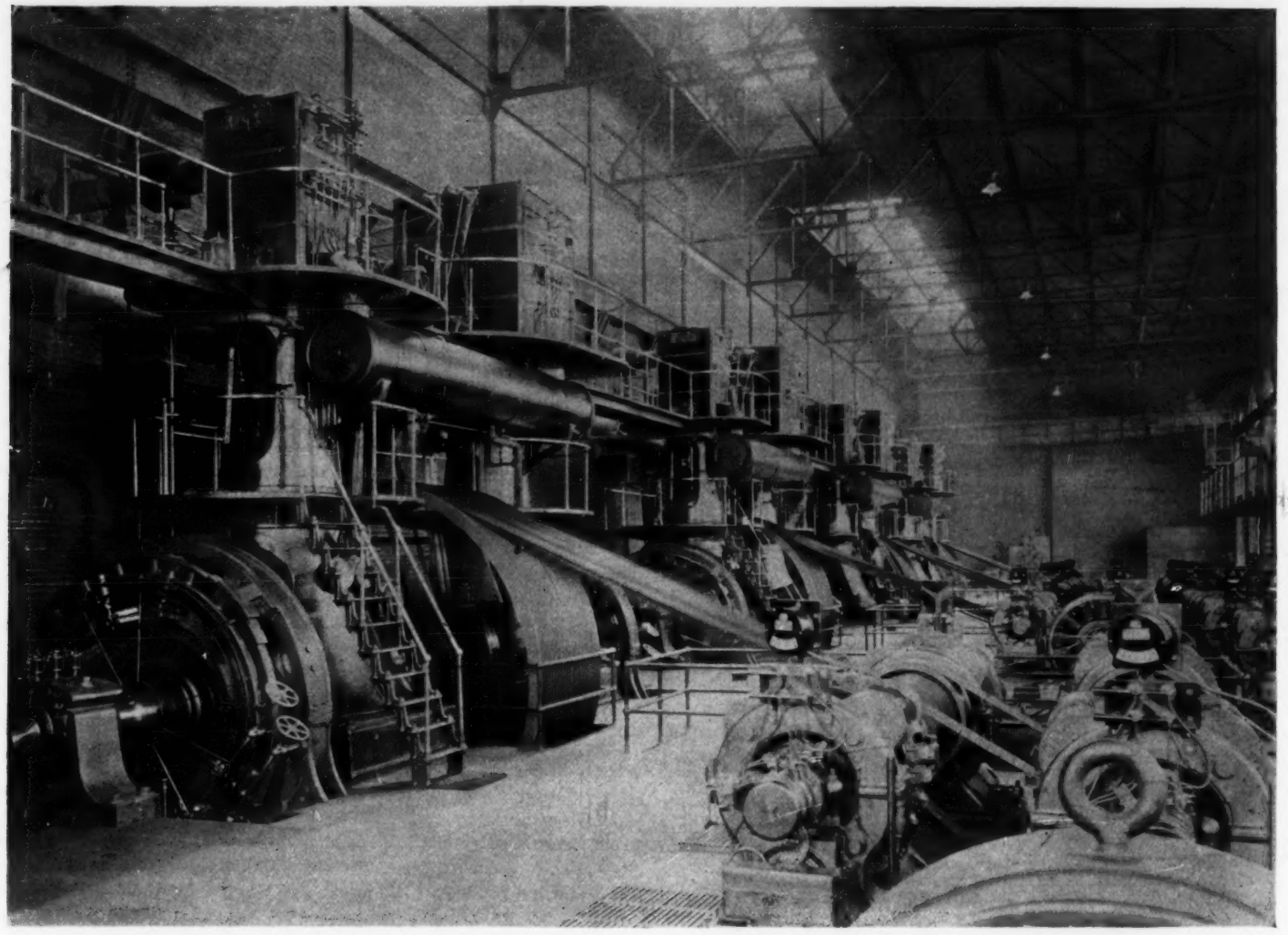


FIG. 1.—ENGINE AND GENERATOR ROOM, NOW BEING ALTERED.

During the present season underground conduit is to be laid in 43 miles of street. This conduit will be supplied by the American Vitrified Conduit Company, and laid, under contract, by Guy M. Gest. The underground lead-covered cable to go in this conduit is being made by the Safety Insulated Wire and Cable Company.

At the present time all of the street lighting of the city is being done by continuous current, series, 9.6 ampere arcs, supplied by

Brush arc machines. There are now 3,408 of these lamps on the city circuits, for which a price of $84.90 per year is obtained. These are to be replaced by 4,400 enclosed, alternating current, series arcs of 300 watts capacity, or 4 amperes at 75 volts. For these new lamps the contract price is $72.00 per year in the underground district, and $60.00 per year in the outside, overhead district. In the underground district the cable used for the series arc lighting will be No. 6 copper wire with rubber insulation 7-32-inch thick, lead covered.

In the underground district the neat forms of iron pole and brackets, shown in Figs. 4 and 5, will be put up. In the overhead districts iron brackets of the form shown in Fig. 2 are to be used for supporting the city arc lamps. The base, shown in Fig. 4, has a flange bolted to the sidewalk and a portion extending 30 inches below that. Both poles and brackets are the work of the Electric Railway Equipment Company, an order being under way for 1,000 poles and 3,600 brackets. The arc lamps are of a new type of the General Incandescent Arc Light Company, Fig. 3.

As the central station is situated in close proximity to the down-town district, the direct-current, three-wire, 110-220-volt net-work will be retained for supplying light and power for the underground district. This district will be supplied direct from the power house by direct-current generators, as heretofore. All the resf of the company's current will be generated as 60-cycle, alternating-current. three-phase, with 4,000 volts between each phase and 2,200 volts between each leg of the circuit and the neutral wire when connected Y-fashion. For the series arc lighting, this will be transformed

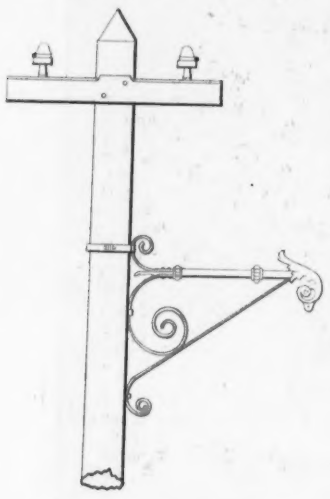


FIG. 2.—ARC LAMP BRACKET FOR WOODEN POLES.

FIG. 3.—ARC LAMP TO BE USED ON ALL STREET LIGHTING.

by General Electric "tub" transformers located at the central station to supply 4-ampere, 60-light circuits. For light and power in the residents or outlying districts, the four-wire, three-phase system is used. Where motors are to be run from this alternating current circuit, the motors or their transformers are connected delta fashion to the three outside legs of the circuit without making use of the fourth or neutral wire. For residence lighting, transformers wound for a primary voltage of 2,200 are connected between the outside legs of the 4,000-volt circuit and the neutral wire.

The transformers will, of course, be distributed so as to maintain as nearly as possible the necessary balance between the three phases. Secondaries of these transformers are wound for 110-220-volt, three-wire circuits. At the present time, these secondary distributions in the residence districts are not run as connected together net-works, although they are arranged so that they can be so run if desired. Each transformer now supplies its own section of secondary wiring, and there is no connection between the secondary circuits supplied by one transformer and those of another. The reason for this separation is that it has been found there is too much danger of overloading some of the transformers connected to the net-work, in case the fuses blow out on other transformers connected to the net-work.

Cincinnati is divided by its almost mountainous hills into a number of fine residence districts, each of which is located on its own hilltop. The incandescent lighting of such districts is supplied by two of these four-wire, three-phase feeder circuits, shown diagrammatically in Fig. 6. These supply Clifton, Avondale, Mt. Auburn and Walnut Hills. The number of transpositions and the way in which transformers are balanced between the various circuits can be seen from Fig. 6. Considerable care was used to see that these circuits were all transposed at proper intervals. As will be seen, there are three transpositions between the power house and the point where feeders begin to be tapped, making a complete transposition of the three-phase, four-wire mains. The method of accomplishing the transposition is shown by Figs. 7, 8, 9 and 10. Fig. 7 is the ordinary arrangement of wires on the cross-arm before reaching a transposition. In Fig. 8, the first step in the transposition has been made by putting a second cross-arm below the main cross-arm and dropping one of the four wires to the lower cross-arm. In Fig. 8 the wire 1 is the one which has been dropped. In Fig. 9 the second step in the transposition is made by running wire 1 diagonally across to a pin on the opposite end of the lower cross-arm from that occupied in Fig. 8. Here also, wires 2, 3 and 4 on the upper cross-arm have all been moved one pin to the right, leaving vacant the pin at the left end o fthe cross-arm. In Fig. 10, wire 4 has been placed on the upper cross-arm, and the pole line resumes its normal form. The insulators on the 4,000-volt, alternating-current lines, as well as on the new series arc circuits, are 4¼-inch diameter glass, made by the Hemingray Glass Company.

In the central generating station, as well as on the street, visitors will find a great change going on. Not only is the station being enlarged to take care of the entire business formerly supplied from a number of stations, but part of the machinery installed is being changed. This plant formerly consisted of a mixture of series arc and direct-current, direct-connected, 110-volt dynamos. To be more explicit, the equipment early in this year in the generating room consisted of five 1,600-hp, vertical, cross-compound, condensing. Reynolds Corliss engines, each driving, by means of a counter shafting, twelve 100-light Brush series arc machines; moreover, each engine also had direct-connected on its shaft two 110-volt direct-current dynamos for supplying the Edison three-wire net-work. Each engine unit thus supplied both arc and incandescent lighting, which was a very flexible arrangement in one way, because there would be portions of the day when there would not be sufficient arc lighting to take the full capacity of one engine. In addition to the combination units just enumerated were two 2,500-hp engines of a similar type, direct connected to both direct-current and alternating-current generators. The plant, as it existed before the present charges were inaugurated, can be seen in Fig. 7. The counter shafting for driving the arc dynamos was driven from the engines by a rope drive and the arc dynamos belted from the counter shafting. The arc dynamos are now all being taken out and the direct-current dynamos on these engines are also being removed to make way for larger direct-connected machines, equal to the full capacity of the engine unit.

In place of these small direct-connected generators on the old engines there will be placed one 2,500-kw, three-phase Bullock alternator and four 450-kw, direct-current generators, for supplying the direct current Edison net-work. In addition to these direct-current, direct-connected units for suppying the Edison net-work at light-load periods; and in order to make most economical use of the various generating units in the station, two 500-kw motor-generator sets have been ordered. These motor-generators will be arranged to take the 4,000-volt, three-phase alternating current at the motor end and generate 300-volt direct current for the outer wires of the Edison net-work. A 2,500-kw, direct-current machine will also be installed later.

The three-phase alternator, built by the Bullock Electric Manufacturing Company, is designed for 2,500 kw, normal load, and 3,120 kw, continuous overload. It will generate 4,500 volts between terminals, and operate at 75 r. p. m. The generator has 96 poles, and, therefore, produces alternating currents of 60 cycles.

The conditions for which this machine had to be designed are rather exceptional, as may be seen from the fact that the machine is the largest of its kind in this country. The generators in some of the New York traction companies' stations have a larger output, but they are designed for 25 cycles and have not more than 40 poles, while the generator built by the Bullock Company for the Cincinnati Company has 96 poles. It is apparent that the construction of a machine which requires the placing of so many poles on the circumference of a wheel offered problems to be solved by the engineers of a nature far more difficult than those that have to be solved for

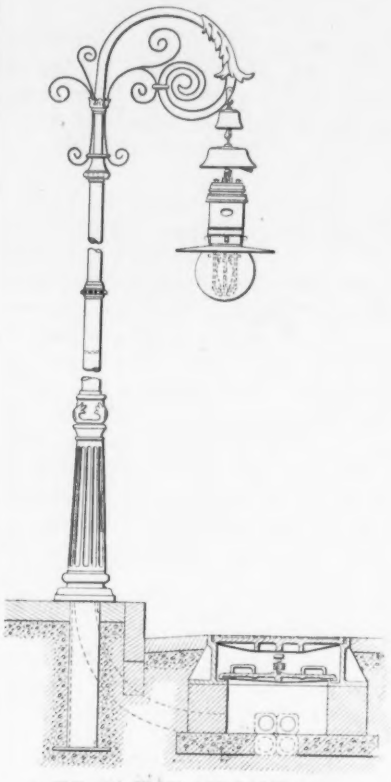


FIG. 4.—IRON ARC LAMP POLE.

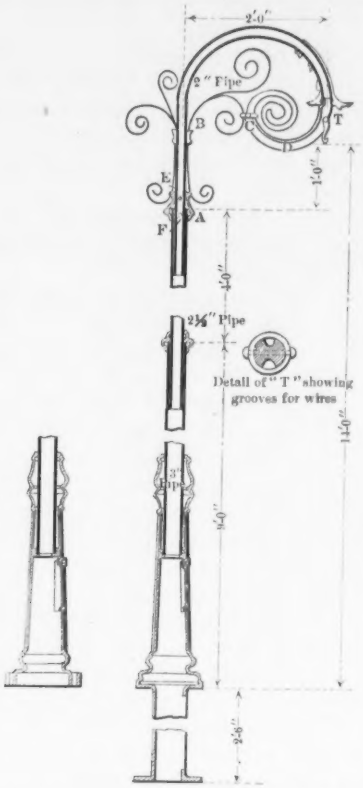
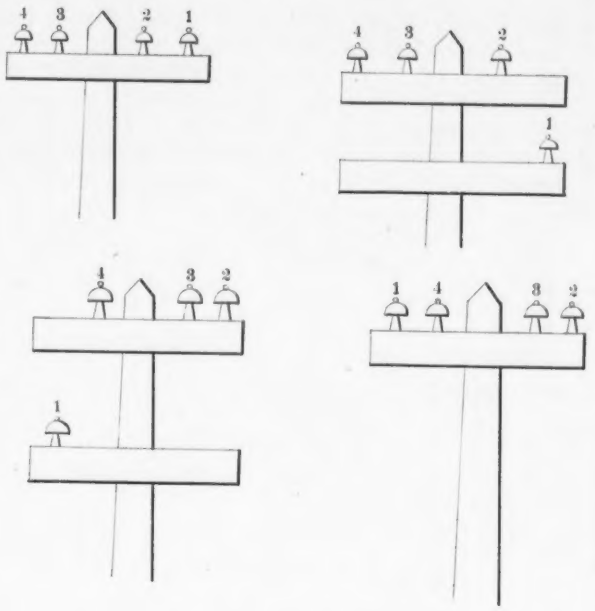


FIG. 5.—LONGITUDINAL SECTION OF IRON ARC LAMP POLE.



FIGS. 7, 8, 9 AND 10. —TRANSPOSITION DIAGRAMS FOR POLE LINE.

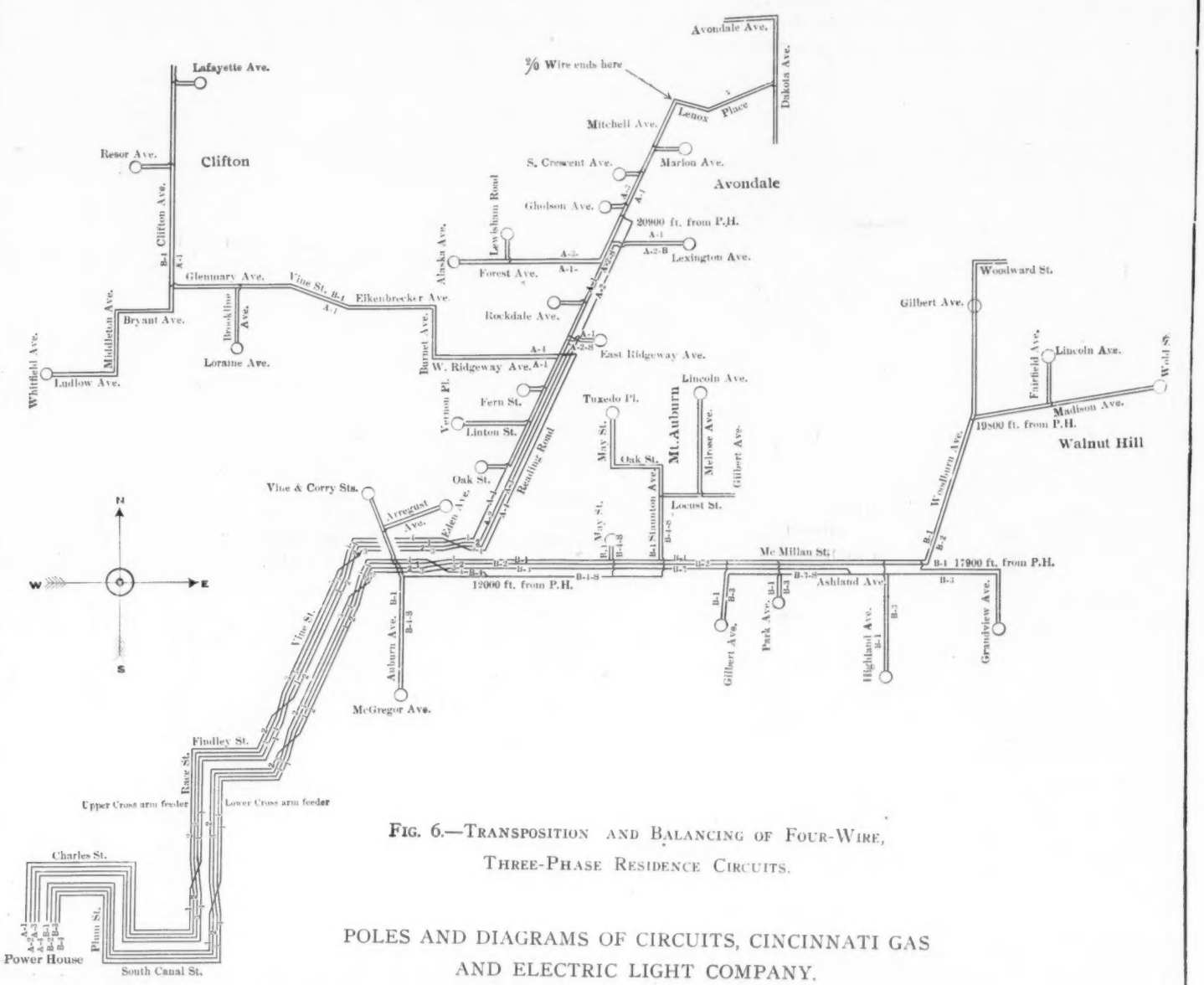


FIG. 6.—TRANSPOSITION AND BALANCING OF FOUR-WIRE, THREE-PHASE RESIDENCE CIRCUITS.

POLES AND DIAGRAMS OF CIRCUITS, CINCINNATI GAS AND ELECTRIC LIGHT COMPANY.

low-frequency generators, requiring only a moderate number of poles.

The general construction of the alternator may best be seen from Figs. 7 and 8, showing a detailed assembly and an outline of the generator, respectively. The question that had to be solved at the outset was whether it would be advisable to build the generator as a fly-wheel generator, using the fly-wheel to carry the poles, or whether the generator should be built as a self-contained, engine-

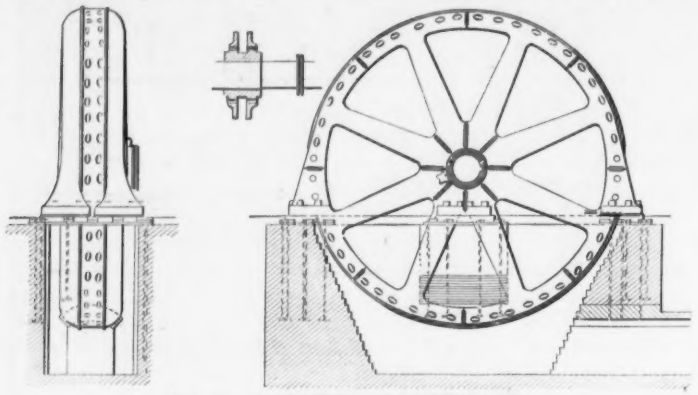


FIG. 7.—ELEVATIONS OF ALTERNATOR.

type machine with a separate fly-wheel alongside of it. There are some advantages and some drawbacks in either construction. The fly-wheel-type generator requires a large diameter in order to be able to reduce the weight of the fly-wheel for a given moment of inertia, which necessitates a heavier construction for the large armature to obtain rigidity and stiffness. On the other hand, the engine-type generator, being of smaller diameter, requires the construction of a special rotor to carry the poles, and thus the advantage obtained by a smaller diameter of the generator might well be considered compensated for by the necessity of making two revolving parts and the greater space taken up by the combination.

Aside from the greater engineering difficulties connected with the building of generators of very large diameter and narrow core, there are several great advantages connected with a large machine in which the armature is narrow. As is apparent in looking at the drawing, the radiating surfaces of this machine are very large, and, therefore, it is possible to design economical machines in which the temperature rise does not exceed 30° C. at normal continuous load.

It will be interesting to give some of the dimensions of this mammoth machine. The outside diameter is 30 feet and the inside diameter is 34 feet. The length of the pole, measured along the shaft, is 11 inches. It will also be instructive to study the weights of this machine, and we give, therefore, in the following, a general idea of the distribution of copper, steel and iron in the machine:

The total weight of laminated steel in the armature and poles is 42,000 lbs. The total amount of copper on the armature and on the fields is 13,100 lbs. The shields, the construction of which will be presently described, weigh 128,400 lbs. The whole stationary part, including steel and armature copper, weighs 200,000 lbs. The revolving part, which is the fly-wheel of the steam engine, the weight of which will, of course, be determined by the inertia demanded by the engine builders, is 374,800 lbs. The total weight of machine is thus 574,800 lbs.

On account of the large size of the armature, it is built up between two shields, each of which was made in eight sections, as clearly shown by the drawings. The armature itself is made up in 24 sections, each of which can be removed. The winding is placed in open slots, there being two slots per pole and per phase.

The electrical guarantees of this machine will be of interest. The regulation at 100 per cent. power factor and full load will not exceed 7 per cent. The efficiencies are as follows: 1½ load, 96½ per cent.; 1¼ load, 96½ per cent.; full load, 96¼ per cent.; ¾ load, 95½ per cent.; ½ load, 94 per cent.; ¼ load, 91 per cent.

The temperature rise at full load after 24 hours will not exceed 30° C.; at 25 per cent. overload after 24 hours, it will not exceed 40° C.; and at 50 per cent. overload after one and one-half hours it will not exceed 50° C. It will be of interest to call attention to the fact that this generator requires only 24 kw for excitation at full load in spite of the good regulation obtained.

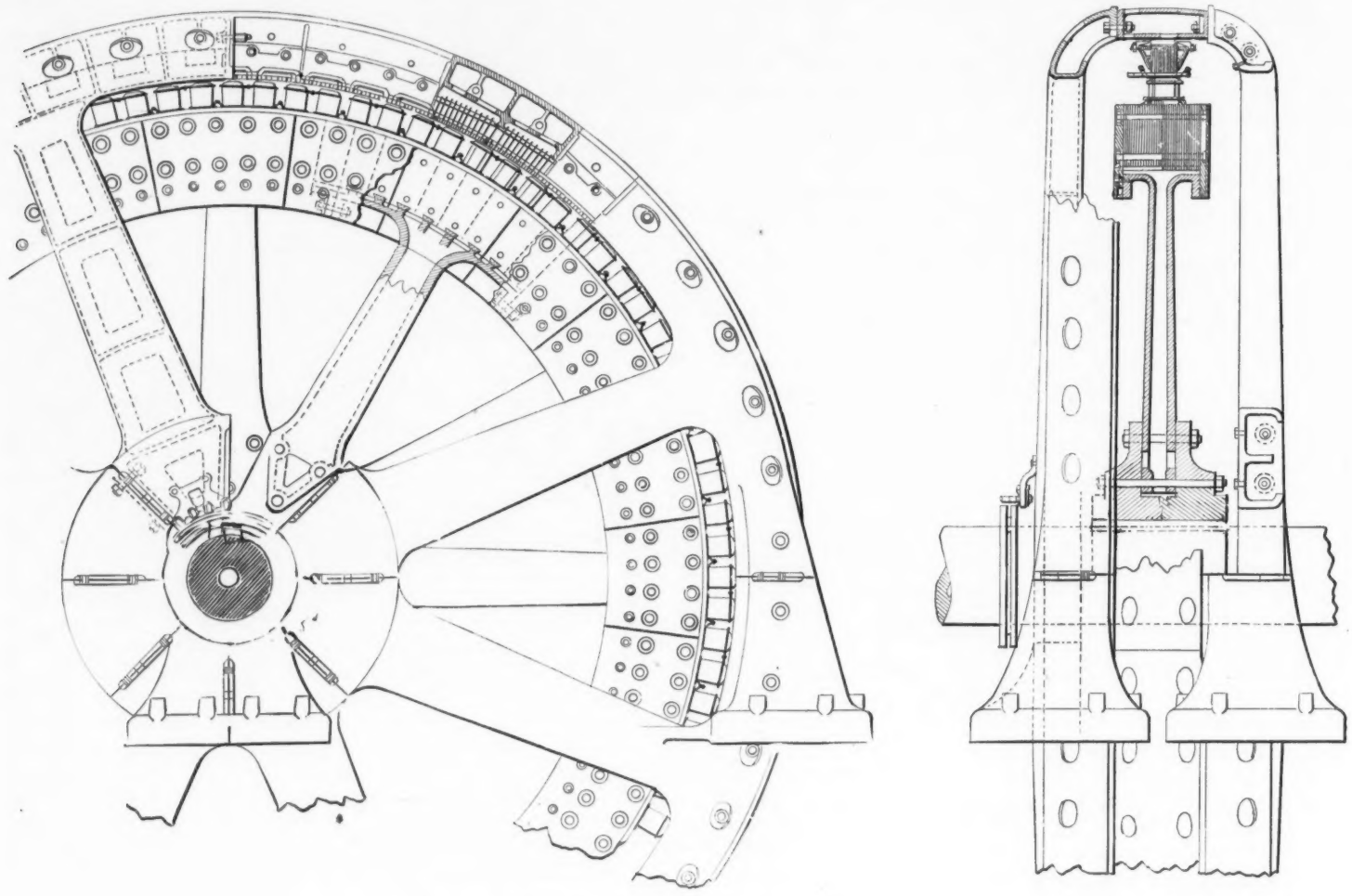


FIG. 8.—SECTIONAL DETAILS OF ALTERNATOR.

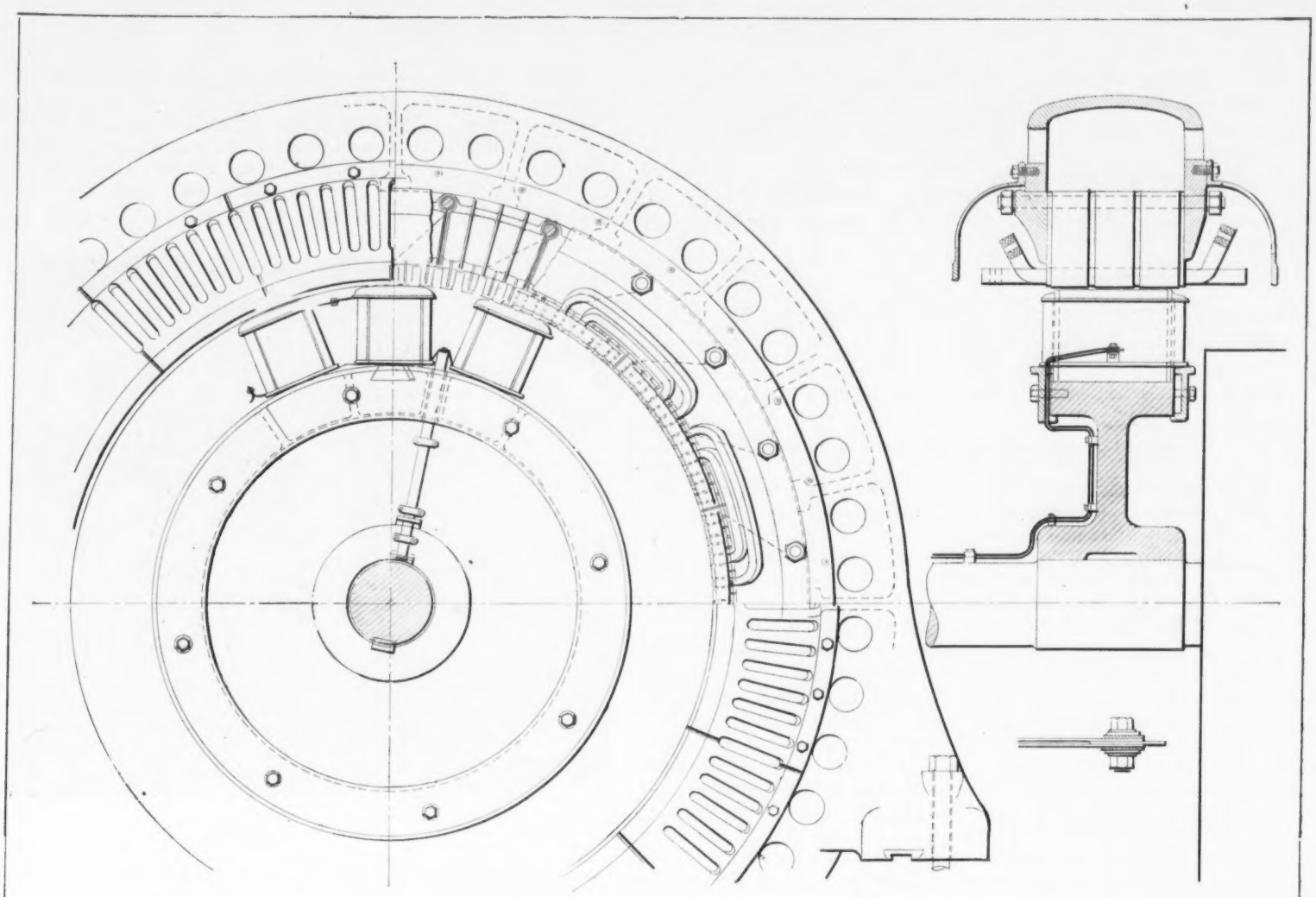


FIG 9.—SECTIONAL DETAILS OF 500-KW MOTOR-GENERATOR SET.

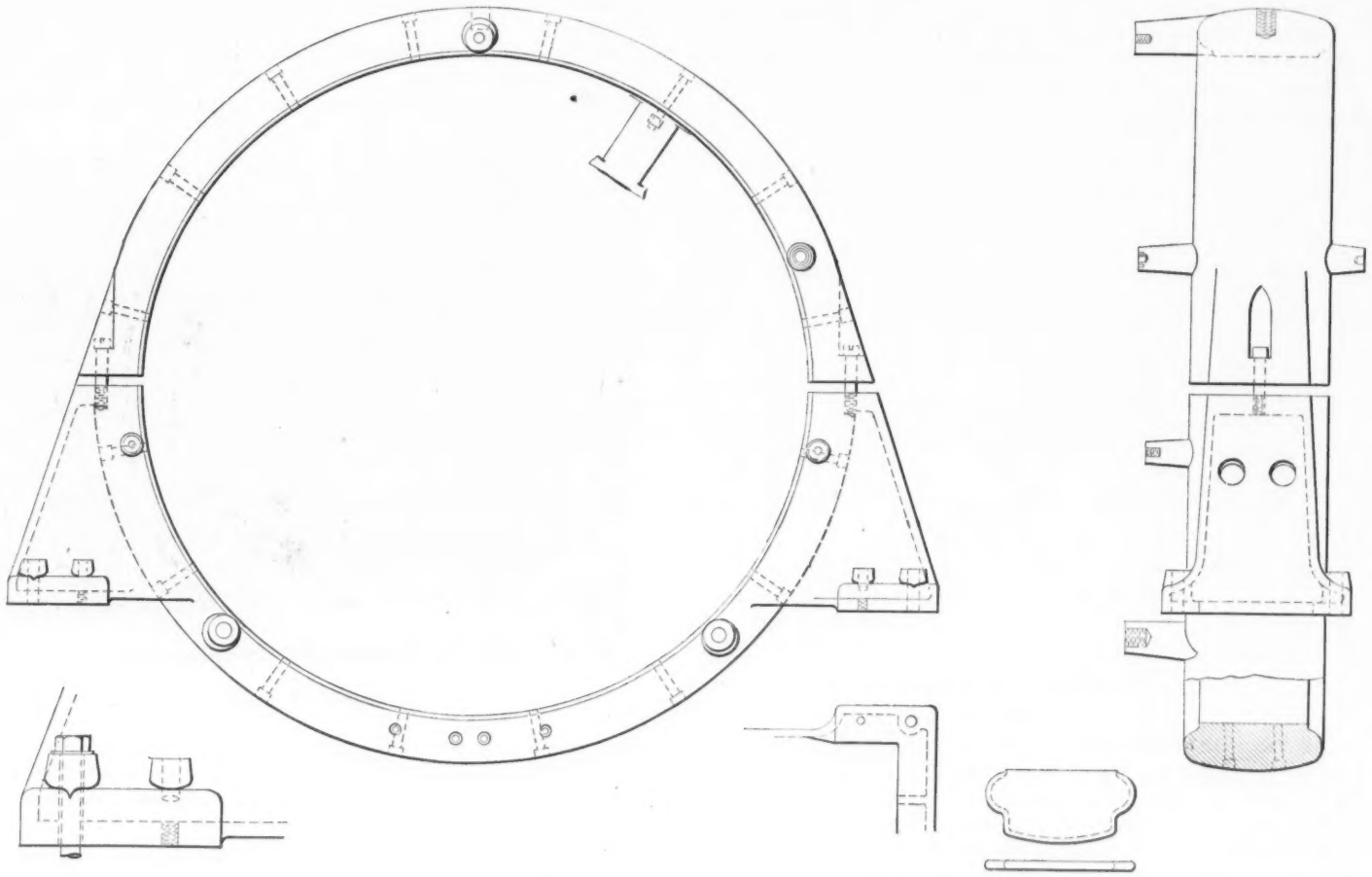


FIG. 10.—MAIN FEATURES OF CONSTRUCTION OF 450-KW ENGINE-TYPE GENERATOR.

Figs. 9 and 11 show the 500-kw motor-generator sets. The synchronous motor is wound direct for 4,500 volts, and operates at 450 r. p. m. It, therefore, has 16 poles. The revolving element consists of a steel wheel, in which slots are milled to receive the dove-tails of the laminated poles. These revolving fields are mechanically so well constructed that they can stand the enormous peripheral speed of two miles per minutes, or more. The general construction of

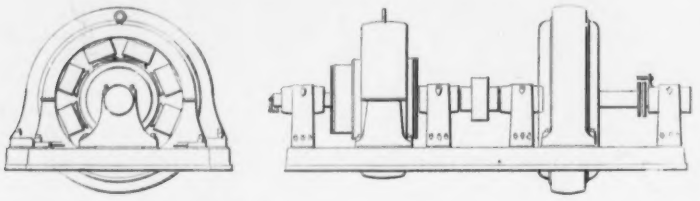


FIG. 11.—ELEVATIONS, 500-KW MOTOR-GENERATOR SET.

these synchronous motors is identical with the construction adopted by the Bullock Company for its revolving field alternators.

The direct-current machines that are to be installed by the Bullock Company comprise seven units, four being engine-type generators, rated as 450 kw, 150 volt, 120 r. p. m., and two rated as 500 kw, 300 volt, 450 r. p. m., which latter are to be driven by synchronous motors, and one rated as 2,500 kw, 300 volt, 75 r. p. m.

Fig. 10 shows the main features of construction of the four 450-kw engine-type generators. The field yoke consists of an annular cast-iron ring, with inwardly projecting poles. The poles are built up of laminations of sheet steel in such a manner as to reduce to a minimum the effect of armature reaction. The poles are held in place by fillister-head cap screws. By taking out these cap screws it is possible to slide the poles out parallel with the shaft without disturbing either the armature or the field yoke. The armature spider has its arms milled at the outer ends so as to fit into dove-tailed notches in the armature segments. This method of construction for armatures built up of segments produces an armature in which the stresses due to centrifugal force are resisted by the strength of the armature steel, and the only stress put upon the cast-iron spider arms is of a crushing nature.

The armatures of these machines are well provided with ventilating ducts and, as the armature coils are held in the slots by means of wooden wedges, these ventilating ducts are not closed by any bands or wire around the outside. The commutator sleeve is cast in one with the front end head of the armature, thus making the commutator an integral part of the armature.

In commutators having diameters equal to or greater than those in the present machines, the front ring is cut into segments to facilitate handling.

Fig. 12 is an outline of the 2,500-kw, 300-volt, engine-type generator. This machine has 48 poles with an external armature diameter

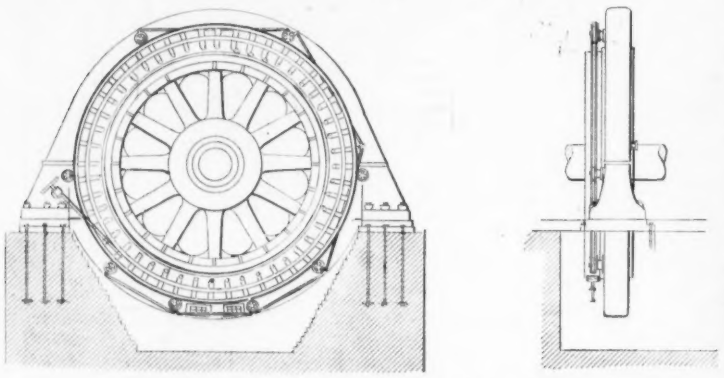


FIG. 12.—ELEVATIONS OF 2,500-KW ENGINE-TYPE DIRECT-CURRENT GENERATOR.

of 20 feet. In construction it does not differ materially from the 450-kw generator described above. One feature shown in this drawing that is peculiar to the large engine-type generators of the Bullock Company's manufacture is the device for oscillating the rocker arm carrying the brush holders. By means of this addition, a motion of the brushes is obtained parallel to the shaft which is similar to the end play of the armature in a belted machine, whereby the brushes are prevented from wearing grooves in the commutator.

While the nominal rating of this generator is 2,500 kw, it is guaranteed to carry continuously a 25 per cent. overload, and is also guaranteed to have a full load efficiency of 95 per cent.

Additional land has been purchased adjoining the present station at Plum and Charles Streets, and the power house is to be enlarged by the addition of two 4,000-hp Reynolds Corliss engines, to be built by the Allis-Chalmers Company. These are to be of the combined horizontal and vertical type, similar to those being put in

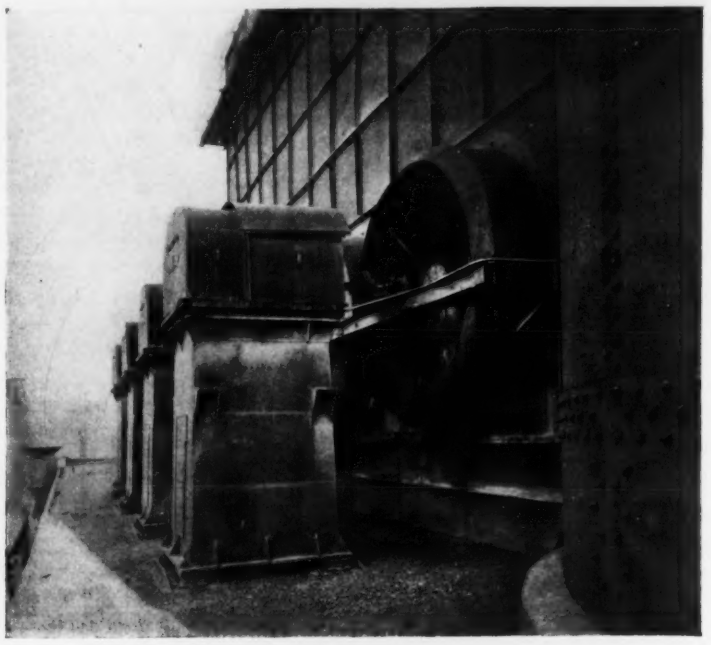


FIG. 13.—COOLING TOWER.

the Manhattan Railway power station, in New York. To one of these engines the above-mentioned 2,500-kw, direct-current Bullock generator, for supplying the outer mains of the Edison net-work, will be connected. On the other engine a 2,500-kw, three-phase, 4,000-volt alternator, also to be made by the Bullock Company, will be placed.

The present boiler plant has six 550-hp and two 300-hp Babcock & Wilcox boilers, with American under-feed stokers. The coal bins above these boilers provide for the storage of 2,000 tons of coal.

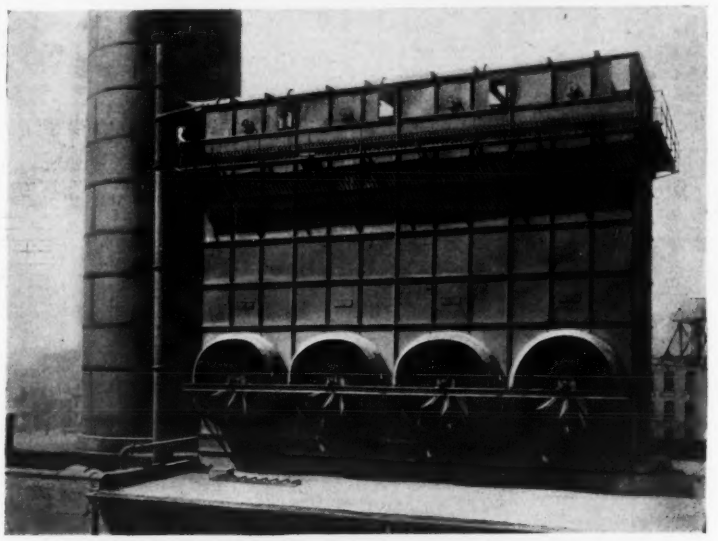


FIG. 14.—ROOF VIEW ON PLUM STREET.

The McCaslin conveyor system carries the coal from the wagons, where it is unloaded to the bins. The plant is all designed to operate condensing, as it adjoins the Miami and Erie Canal. Condensers are supplied by the Southwark Foundry and Machine Company, the central feature of the boiler room being an immense Weiss condenser. The condensers are supplied by a Birbus rotary pump, driven by Southwark engines. As it frequently happens that "the powers that be" see fit to let the water out of the canal without warning, it has been necessary to put a Wheeler cooling tower on

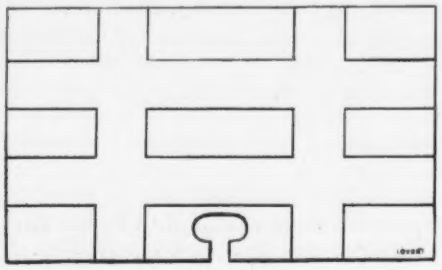


FIG. 15.—DIAGRAM OF CITY BLOCKS AND STREETS.

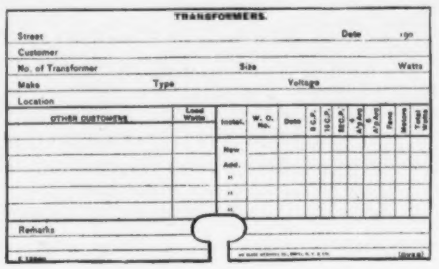


FIG. 16.—TRANSFORMER RECORD CARD.

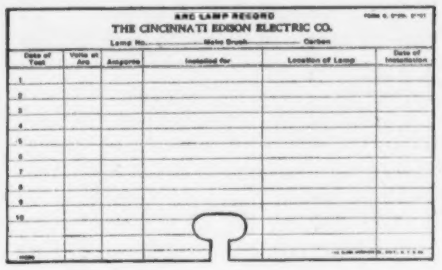


FIG. 17.—ARC LAMP RECORD CARD.

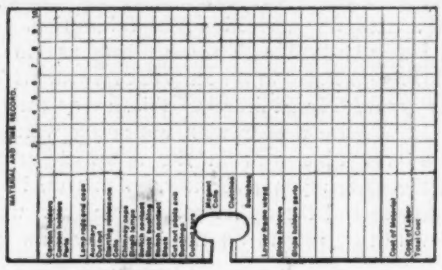


FIG. 18.—BACK OF ARC LAMP RECORD CARD.

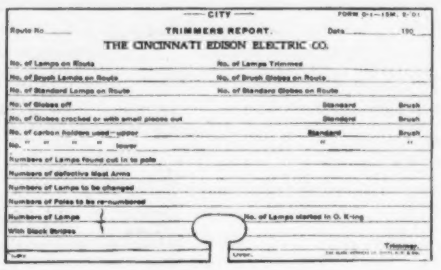

CITY
TRIMMERS REPORT.
Date
THE CINCINNATI EDISON ELECTRIC CO.
Route No.
No. of Lamps on Route
No. of Lamps Trimmed
No. of Brush Lamps on Route
No. of Brush Globes on Route
No. of Standard Lamps on Route
No. of Standard Globes on Route
No. of Globes off
Standard
Brush
No. of Globes cracked or with small pieces out
No. of carbon holders used—upper
lower
Numbers of Lamps found out in to pole
Numbers of defective Mast Arms
Numbers of Lamps to be changed
Numbers of Poles to be re-numbered
Numbers of Lamps
No. of Lamps started in O. K-ing
With Black Stripes
Trimmer
Over.

FIG. 19.—TRIMMERS' DAILY REPORT CARD.

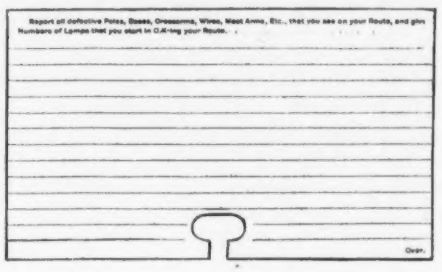

Report all defective Poles, Bases, Crossarms, Wires, Mast Arms, Etc., that you see on your Route, and give Numbers of Lamps that you start in O.K-ing your Route.
Over.

FIG. 20.—BACK OF TRIMMERS' DAILY REPORT CARD.

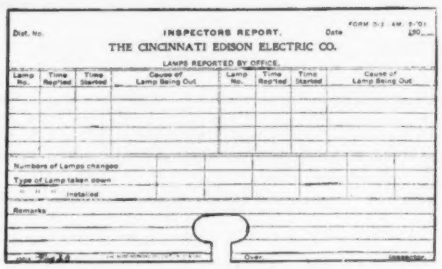


FIG. 21.—NIGHT INSPECTOR'S REPORT CARD.

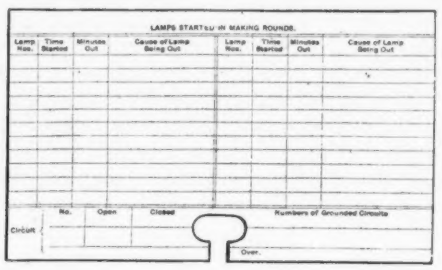


FIG. 22.—BACK OF NIGHT INSPECTOR'S REPORT CARD.

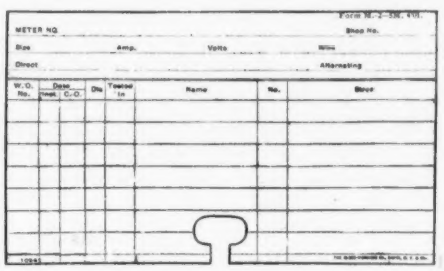


FIG. 23.—TEST REPORT CARD OF METER ON LINE.

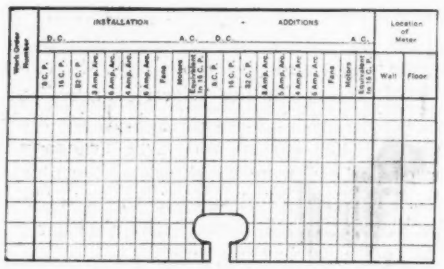


FIG. 24.—BACK OF TEST REPORT CARD OF METER ON LINE.

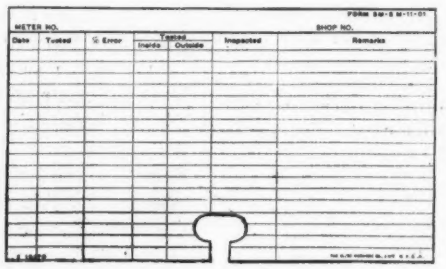


FIG. 25.—SHOP TEST METER RECORD CARD.

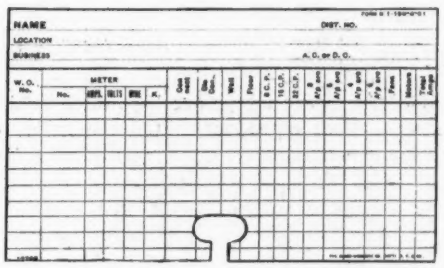


FIG. 26.—METER LOCATION CARD.

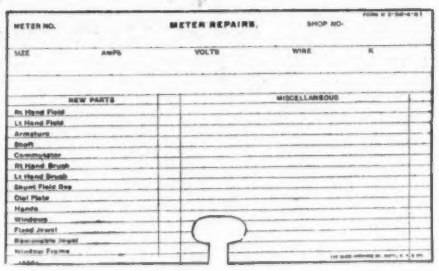


FIG. 27.—METER REPAIR CARD.

CARD INDEX SYSTEM OF THE CINCINNATI GAS AND ELECTRIC COMPANY.

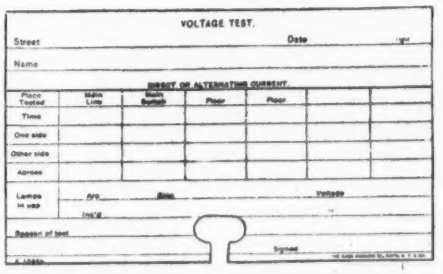


FIG. 28.—VOLTAGE TEST CARD.

the roof, which can be seen in Figs. 13 and 14. Fig. 14 is a view on Plum Street, showing the exit of the overhead lines from the station, along the canal. Many of these wires are soon to go underground, and some idea can be obtained from this as to the amount of the underground work necessary. In the new part of the plant are to be eight 550-hp Sterling boilers, equipped with McCaslin conveyors.

Near the center of down-town distribution the company has a large storage battery of the chloride type connected to its Edison three-wire net-work. This battery is on Government Place, near Fountain Square, in the building formerly used for the general offices of the Cincinnati Edison Electric Company. The battery capacity is 4,400 ampere-hours, discharging at a one-hour rate. The total number of cells is 166, and there are five cells on each side of the three-wire system which are not used. In connection there are two booster sets. Each set consists of two generators driven by a 175-hp engine. Each of the booster generators is capable of increasing the voltage on its side of the Edison three-wire system 70 volts, and of passing 800 amperes.

Since the consolidation much effort has been expended in systematizing the details of operation, so that the heads of departments might be familiar with everything going on over the entire system, and the exact condition of affairs. The company now has a large map of the city of Cincinnati, showing the location of every pole owned by the company. Such a map is, of course, of immense value, but is also the result of an immense amount of work after the consolidation of so many small companies, some of which kept no records of construction. The company has now some 15,000 poles planted in the city of Cincinnati. Mr. Pfiester makes extensive use of the card index system in keeping track of the details of construction and operation pertaining to the distributing system. In view of the completeness of this system, it will, no doubt, be of interest to reproduce here some of the cards used.

When transformers are installed their data and location are noted on a special card for the purpose, which is kept on file, a copy of which is here shown in Fig. 14. On this all the important information about the transformer can be seen at a glance. The first customer on the transformer is put at the top part of the card, and a space left for other customers on another part of the card, as seen. On the back of the same card is a diagram of a city block and streets in blank, upon which the location of a transformer on a block can be marked and the street names and numbers filled in. With a card index of transformers properly kept up there is no danger of the overloading of a transformer, and much trouble is saved by being able to tell in a moment at the office whether additional customers can be put on any transformer and whether prospective customers are in reach of transformers already up. When a transformer is taken down or the wiring of a district remodeled, the cards are simply taken out of the index and new ones filed, so that the index is not burdened with dead records as would be the case with any bound-book system.

Records of arc lamps are kept on a card for the purpose, one of which is here reproduced. On the front of this card, Fig. 17, is the lamp number and make, with blanks for date of test and location. On the back, Fig. 18, are spaces for entering material and time expended in the repair of the lamp. As the company has heretofore had four types of lamps in use, there are four different colored cards. The front and back of the cards for the old Brush lamps are those here reproduced. Trimmers of street arc lamps make out a daily card report of the form shown, Fig. 19, and on the back of this report, Fig. 20, note is made of all defective poles, bases, cross-arms, wires, etc., that the trimmer sees on his route, and gives also the numbers of the lamps that failed to start when the current is turned on. In this connection it may be well to mention that each trimmer is required to "O.K." his route every night before being let off for the day. That is, he must see that all the lamps trimmed by him during the day have started, and if they have not started to fix them before leaving. Routes are arranged as far as possible, so that trimmers will not have to travel far to see whether all their lamps have started.

For the 3,408 city lamps there are 31 trimmers. There are 3,758 direct-current, constant-potential, enclosed arc lamps in commercial service, and 14 trimmers take care of this commercial work. Very close track is kept of the city street lamps, both by the police department of Cincinnati and by the company. Lamps out are reported promptly by the police department to police headquarters, and from there to the electric light company's offices. The man on duty at the latter office immediately calls up the inspector or trouble man in the district in which the lamp is out, giving him the number of the lamp. A book is issued by the company for the use of the policemen and the company's employees, giving the location of every street lamp in the city and the number of the lamp. Policemen in reporting lamps out, report simply the lamp number. Nine inspectors, or trouble men, are kept on duty all night to answer calls of this kind. Each man is given a certain district, so that in times of emergency a trouble man from one district may be transferred to another district if one man has more trouble than he can attend to. The inspectors of each district turn in a card report, Figs. 21 and 22, every day showing the lamps reported out, lamps started and lamps changed. As a check on this there is the record of the night telephone man at the electric light office, taken from the lamps reported out by the police department.

Meter inspection and repair records are also kept by a card index. This company represents probably the extreme in the matter of frequent taking down meters for inspection and calibration. The Thomson meter is the standard, though some others are in use. Every meter is taken down and tested in the shop once a year without regard to its previous record. In addition to this, every meter is tested in its place at least twice a year with indicating wattmeter and stop-watch. There are nine men in the meter department doing this work, and the company has about 7,000 meters, including those that are in service and those that are in stock and undergoing calibration. For testing meters on the line, a yellow card, Figs. 23 and 24, is used, and for shop testing of meters a white card, Fig. 25. For the location of meters a buff card, Fig. 26, is used, The record of meter repairs is kept on Fig. 27. Voltage tests are frequently made at various places over the system and records of these tests are also kept by a card index system, using the form shown, Fig. 28.

The rates for electric light are 10 cents per kilowatt-hour, with a sliding scale giving discounts as high as 40 per cent. for consumption for over 9 kw-hours per month per 16-cp lamp installed. In addition to the discounts allowed by the sliding scale, 5 per cent. discount is allowed on all bills paid within five days. For power, the rate is 10 cents per kw-hour, with a sliding scale allowing a discount up to 60 per cent. when over 800 kw-hours are used in a month. The total of incandescent lights and power now being supplied by the company amounts to a maximum equivalent of 340,847 incandescent, 16-cp lamps. A few of the down-town streets of Cincinnati are partially lighted, independent of the city lamps, by arches of 32 incandescent lamps. These arches consist of gas pipe extended from curb to curb. This lighting is paid for by the merchants along the street, $34 a month being received for each arch.

The capital stock of the Cincinnati Gas and Electric Company is $29,000,000, no bonds being issued. Of this about $9,000,000 is in the electric department.

In addition to the regular light and power business, the company is under contract to furnish power for the "electric mules," as the electric locomotives are called, which are to supplant the mule on the Miami and Erie Canal. The Miami and Erie Transportation Company has built a track and ordinary overhead trolley along the towpath for this purpose. The lines of the Southern Ohio Traction Company for some distance out of Cincinnati will also use power from the Cincinnati Gas and Electric Company.

Telephony in Baltimore.

At Baltimore, Md., on May 8, a committee of the city council held a meeting to consider the ordinance which authorizes the Independent Maryland Telephone Company to raise its rates. The company was represented at the meeting by President Bouton, of the telephone company, and the former president, Mr. George R. Webb. The ordinance which Messrs. Webb and Bouton are trying to push through provides for an amendment of the ordinance under which the company is now doing business, so that the present rate for telephones —$48 a year for a business house or office, and $36 for a dwelling— may be raised. The company asks for an office rate not to exceed $78 a year until more than 12,000 telephones are in use, and not to exceed $84 until more than 15,000 are in use. For homes they ask a rate of not more than $60 a year until more than 12,000 telephones are installed, and not more than $72 until more than 15,000 are installed. Messrs. Webb and Bouton explained that the cost of operation of a telephone system increases by a geometrical ratio.

A Successful Suburban System.

BY ALTON D. ADAMS.

GREAT systems of electrical supply command a share of attention that is out of proportion to their part of total lighting and motor loads for all plants. Important as it is that the few plants of surpassing extent should include generating stations of high efficiency and flexible, economic systems of distribution, these features are still more desirable for the great body of small and medium plants that do the greater part of electrical work. Thus far the great systems have been, as a rule, more ready to adopt the best engineering methods than the smaller ones. It is, therefore, especially interesting and important to note advances of the latter along these lines. Most managers of central stations will, perhaps, agree that a service area composed almost entirely of suburban territory is not the easiest one to serve with satisfactory results.

Such a territory constitutes the field of operations for the Malden Electric Company, the subject of this sketch. Opposite that part of Boston called Charlestown, just north and east of the Mystic River and Lakes, are the suburban cities of Everett, Medford, Malden and Melrose. Though cities in name, these four municipal corporations are really a part of the great residential and manufacturing district of which the older part of Boston is the business center. Throughout the territory such distinguishing marks of cities as large retail stores, theaters and hotels, usually important customers of central stations, are almost entirely absent.

The scattered character of the service supplied by the Malden system may be gathered from the fact that while the population of the territory covered by its lines was only 89,206 on June 30, 1891, the length of the overhead lines was 3,447,021 feet, and there was also 1,200 feet of wire in conduits. This length of distribution lines is greater than that of any other system in the State, except one at Boston. To support these lines 8350 poles were in use, a number surpassing that of any other plant in Massachusetts. The overhead wires just mentioned extend over 147 miles of streets. Further intimation of the character of the lighting load in the territory of the Malden plant may be found in the fact that with 1419 customers using commercial incandescent lamps on the date above named, the total number of such lamps connected to the system was 33,451, or an average of only 23 lamps per customer.

A comparison is here instituted between the station equipments, connected loads, energy outputs and fuel consumption of the Malden system in the calendar years of 1898 and 1901, because the earlier year shows a typical plant of the old style, while the later one shows the change to improved generating machinery and methods of distribution nearly completed.

On Jan. 1, 1898, the generating station of the Malden Electric Company contained the following equipment:

Nine boilers rated at 125 hp each, a total of 1,125 hp. Four of these boilers were made by Roberts, three by Kendall and two by the Atlantic Works.

Eight engines, with a total rating of 1025 hp. These engines included five made by Armington & Sims, each with cylinders 13x12, and rated at 300 r.p.m. and 80 hp. One McIntosh & Seymour, cylinder 14½, 15, 125 hp at 225 r. p. m. Two Green engines, each with cylinder 20x42, and rated at 250 hp and 100 r.p.m. The six smaller engines were each belted direct to a generator, but the two larger engines were each belted to a 5-in. shaft 25 ft. long. These two shafts could be coupled by a friction clutch.

The arc lighting equipment comprised six Thomson-Houston dynamos, four of 50-lamp each, one of 45-lamp and one of 75-lamp capacity. There was also one Brush arc dynamo, with capacity for 75 lamps, making a total of 440-lamp capacity for the seven dynamos. These lamp ratings are all based on nominal 1200-cp arcs, taking 6.8 amperes.

The equipment of alternating generators included two of 2400, one of 2000, one of 1400, one of 1200 and one of 600 lamps capacity, giving a total capacity for 10,000 lamps in the seven machines. These alternators were all of the Thomson-Houston make. Three dynamos for direct currents were in use, one of 500-lamp capacity at 110 volts, and two at 500 volts of 7½ and 62 kilowatts respectively, all being of the Thomson-Houston pattern.

The switchboard in 1898 was of the skeleton type, 10 feet high, and with a total length of about 75 feet .

This old equipment thus comprised 9 boilers, 8 engines and 17 dynamos, all of the latter being belt connected.

Engines were all simple and non-condensing, and the boiler gases escaped directly to the chimney.

In contrast with this old equipment, the station now contains the following apparatus: Two Cahill horizontal water-tube boilers, each with 192 tubes 18 ft. long, two 42-in. steam drums, 68 sq. ft. of grate surface and rated at 450 hp. Also, four return-tube boilers, each 6 ft. in diameter, 16 ft. long, containing 126 tubes of 3 ins. diameter, 36 sq. ft. of grate surface and rated at 125 hp. The present boiler capacity is thus 1500 hp.

Instead of the eight engines formerly employed only four are now in regular use, namely: one Ames tandem-compound, cylinders 15½x26½x18, rated at 385 hp; one Rice & Sargent tandem-compound, cylinders 14x28x36, rated at 500 hp; and two Rice & Sargent cross-compound, each with cylinders 18x36x42 and rated at 750 hp. These four engines have a combined rating of 2385 hp and are all operated condensing. Condensers for the 385 and 500-hp engines were made by the Deane Steam Pump Co., and for the two 750-hp engines by the Geo. F. Blake Mfg. Co. Water for these condensers is cooled in a water tower of 1000-hp capacity, and two more of these towers are to be erected.

A Green economizer of 1000-hp capacity now receives the boiler gases and heats the feed water for the boilers.

The main electric generating equipment now consists of four dynamos, instead of the seventeen machines formerly employed. All of these generators are of the alternating monocyclic type, made by the General Electric Company, and operate at 2,200 volts. One generator has a capacity of 250 and one of 300 kw, while the other two generators are of 500 kw each. The smallest of these generators has a revolving armature, but in the other three the magnets revolve. The combined capacity of these generators amounts to 1,550 kw. Two exciter sets are regularly employed with these generators, each set consisting of a 30-kw, 125-volt, direct-current dynamo coupled to a 40-hp, 220-volt, three-phase motor. There is also one engine exciter set for use in emergency only, consisting of a 30-kw, 125-volt dynamo, belted to a 14½ x 15 single-cylinder engine. All of the main generators are direct connected to the engines previously named.

The present switchboard is made up of twenty-five marble panels, each 30 ins. wide and 90 ins. high, so that the total length of the board is 62.5 ft.

With the old equipment the alternating lines were operated at about 1,000 volts. To correspond with the later equipment, all transformers have been changed to those of 2,000 volts primary and of the H type. At the beginning of 1898, 551 transformers were connected to the lines of the system, having a total capacity of 826 kw, and an average of 1,500 watts each. On January 1, 1902, the number of transformers so connected stood at 580, with a total capacity of 1,160 kw and an average of 2,000 watts each. The fact that in spite of the changes of transformers it has been necessary to keep the average capacity at so low a figure illustrates again the very scattered character of the service.

During the four years from January 1, 1898, to the like date of 1902, the number of electric meters installed increased from 887 to 1,600, a gain of 713. In the same period the number of customers supplied by the system rose from 1,119 to 1,628, showing a gain of 509. The addition of meters has gone on faster than that of customers, because the policy has been to change from contract to meter service. As may be noted, only twenty-eight customers were without meters on the later date. Commercial incandescent lamps to the number of 23,730 were supplied by the Malden system on June 30, 1898, and by the like date of 1902 the number of these lamps stood at 33,450, an increase of 40 per cent. Public arc lamps stood at 270 on January 1, 1898, and at 300 four years later, a gain of sixty. Meantime the arc street lamps have been changed from direct to alternating-current enclosed arcs, operated by three constant current transformers located at the generating station. Each of these transformers has a capacity for 100 lamps, taking 6.6 virtual amperes. From the beginning of 1898 to that of 1899 the number of commercial enclosed arc lamps supplied by the system increased from 15 to 125, a gain of 110. Some commercial arc lamps are still operated by the old arc dynamos, but the change to alternating arcs is being rapidly made.

The number of incandescent street lamps supplied by the Malden system is larger than that from any other plant in the State. At

the beginning of 1898 the number of these lamps was 2,168, and they were operated from the alternating dynamos on the old bank line system. On this system several large single-wire mains were run from one pole of the alternating machine to the different portions of the lighting district. About fifty smaller single wires led out from the switchboard to the street lamps in series, each wire connecting between forty and sixty of these lamps, and then joining one of the large mains. These incandescent street lamps were of 25 cp, and each required 3.5 amperes at 25 volts. Constant current was maintained in these circuits by varying the numbers of lamps connected at the bankboard in the station and by cutting in transformers to raise or lower the voltage of individual lines. It is estimated that these methods of regulation involved a loss of 90,000 kw-hours yearly.

One of the first changes in the old system was the operation of constant-current transformers to operate these incandescent street lamps. For this purpose ten constant-current transformers were installed at the generating station, each of 30-kw capacity at 5.5 virtual amperes, making the maximum voltage 5,454 at full load. It was found desirable to change from 3.5 to 5.5 amperes for these street lamps, because at 5.5 amperes each lamp requires only 16 volts, so that the number of lamps per circuit can be much increased. In this case the original lamp lines were joined in pairs to form the new circuits, one of which is connected to each transformer. The large mains for street lamps and ten of the lamp lines were taken down after the constant-current transformers were adopted, and the use of about $3,000 worth of wire was thus gained. On January 1, 1902, the number of these incandescent street lamps stood at 2,665, showing a gain of 497 during the four years. These street lamps are now controlled from three marble panels, each 30 ins. wide and 90 ins. high, in contrast with the old bankboard, which was 20 ft. long and 8.5 ft. high.

In July, 1900, it was decided to operate the Malden plant twenty-four hours per day, and to change the motor service from direct to alternating, so as to operate only one engine during the hours when the demand for light is small. The change to alternating service for motors was completed in January, 1901, and since that date the motor business has shown a large increase. On the date just named the system was supplying nineteen motors, with an aggregate capacity of 92 hp, and on like date of 1902 the number of motors stood at fifty-two, with 350 hp of total capacity. This amounts to a multiplication of the motor capacity by six during two years. No doubt this large increase of motor business is in part due to the greater area covered by the present 2,000-volt lines over that reached by direct current at 500 volts. The unusually large average of nearly 7 hp each for the capacity of the motors points to a probable use of a part of their number in the small factories that abound in the service area of the Malden system.

Much the greater part of the commercial incandescent lamps supplied by this system have Thomson-Houston bases, and such lamps cost one cent more each than do those with Edison bases. As the Malden company may adopt the policy of free lamp renewals in the near future, it has ordered a sufficient number of adapters to change all sockets for Edison-base lamps. That such a change is highly desirable may be seen from the fact that the company carries a stock of lamps for 104, 106, 108 and 110 volts, and of 4, 8, 16 and 32 cp; also all of these voltages and candle-powers in ground glass globes. The yearly consumption of lamps is about 30,000.

Having noted the structural changes that have been made in this system, it is interesting to study their effects on its operation. During the four calendar years from January 1, 1898, to the like date of 1902 the kilowatt outputs and coal consumption of the Malden station were as follows:

Calendar Year.	Pounds of Fuel.	Kilowatt Output.
1898	10,924,940	1,471,682
1899	11,863,489	1,622,924
1900	13,067,360	2,008,231
1901	13,675,235	2,420,618

From this data it appears that the kilowatt output was greater by 61 per cent in the latest than in the earliest year. During the same period the fuel consumption increased only 25 per cent.

In 1898 the average consumption of fuel was 7.4 lbs. per kw-hour, and for the three following years the figures are 7.3, 6.5 and 5.6 lbs., respectively. This amounts to a gain of 30 per cent in the energy output per pound of fuel. During the year ending December 31, 1901, the energy outputs of the Malden station to its several classes of service were as follows:

	Kilowatt Hours.
All commercial lamps	1,112,065
All street lamps	930,676
Electric power	353,675

Dividing each of these numbers by the total output in kilowatts, it appears that commercial lamps consumed 46, street lamps 38 and motors 14 per cent. of this total.

This sketch would be incomplete without mention of Mr. F. C. Sargent, chief electrician of the Malden company, whose engineering skill has made such good use of the equipment put at his disposal by an able business management. Thanks are especially due Mr. Sargent for aid in the collection of the facts recorded here.

Electric Transmission and California Water Powers.

Recently there has been such a complete demonstration in California of the feasibility of transmitting electric energy at high voltage for great distances, that all important streams within 200 miles of Los Angeles or of San Francisco which are capable of developing substantial water power are being carefully studied. The two factors producing power are the volume of water and the amount of fall, hence the U. S. Geological Survey, owing to its work in gaging streams and topographic mapping, is being called upon from many quarters in connection with these investigations. Frequently investments of many hundred thousand dollars are made or rejected on the basis of these records. The demand for accuracy in the determination of the low summer flow of the stream is particularly severe, and calls are made for a greater amount of detail, both as to the number of points of measurement and as to frequency, than it has been possible to obtain heretofore with the limited funds available for this work. A comprehensive knowledge of a stream can only be obtained after several years of careful study. Manifestly capital seeking investment will not wait to compile the records itself, especially in view of the fact that the result may prove unsatisfactory.

For power developments the low summer flow of the stream is that which is most urgently desired at first. These low volumes doubtless will be supplemented by stored water in the near future. During the past four summers meter measurements of the lowest September flow have been made of nearly all the trunk streams on the western slope of the Sierra Nevadas and Sierra Madres. These measurements are of especial value as these years have been of unusual drought.

The crest of the Sierra Nevadas ranges in elevation from 10,000 to 15,000 feet above sea level and is distant from 50 to 60 miles from the low San Joaquin Valley lands, the elevations of which are less than 500 feet. The streams issuing therefrom have very short steep gradients. Profiles of a large number of them, taken from the contour maps of the United States Geological Survey, are given in Water Supply and Irrigation Paper of the United States Geological Survey, No. 40.

The upper portion of the main streams and their tributaries naturally contain the steeper gradients, and though usually showing a smaller volume of water they afford the greater power possibilities because of the higher available pressure heads. These streams are largely within the various National Forest Reserves. One of their interesting characteristics that has been learned, is that during the late summer months when the water is low, practically all of it comes from the highest portions of the drainage basins, say above elevation of 6,000 feet. In fact, some rivers like the Kern, the Kings and the San Joaquin decrease in volume in the lower half of their mountain courses owing to losses by seepage and evaporation.

Arrangements have lately been made with the Forestry officials of the Interior Department for their superintendents in the future to measure these streams at trail crossings, at high elevations, during their low summer stages, under the direction of J. B. Lippincott, the resident hydrographer of the Geological Survey. It is believed that this will add much to the knowledge of California streams in their upper courses. Heretofore they have not been accessible owing to their remoteness and the absence of any reliable observers.

Bristol, England, Central Station Supply.

ONE of the first English cities to adopt the alternating-current system was Bristol, which in 1893 established a municipal plant on that system. Single-phase, alternating-current machinery was installed to generate at 2,000 volts and a frequency of 93, the secondary pressure being 105 volts. For arc lighting, a direct-current plant was installed. Recently a new station has been erected at Avonbank to supplement the old one at Temple Back.

The latter station is equipped with a boiler plant consisting of 12 Lancashire boilers, 24 ft. x 8 ft., and two Babcock & Wilcox boilers. These supply steam at a pressure of 125 lb. per square inch to eight two-crank engines (for the exciters and arc machines), and 10 three-crank engines directly coupled to the alternators. All the engines are of the Willans type, and, with the exception of one Ferranti alternator, all the dynamos are of Messrs. Siemens Bros. & Co.'s make. The four largest alternator sets have each a capacity of 400 kw, and the total capacity of the plant is 3,150 kw, of which two 125-kw and four 52-kw machines furnish continuous current for exciting, arcs and power. The old station has total connections to its mains equivalent to 3,670 kw for private lighting, 156 kw for public lighting, and 732 b. h. p. of motors, and the maximum load on the station recorded Dec. 23d last, was 2,535 kw. The necessity thus, for a new station was pressing, there being no more room to extend in the old one, and the idea is gradually to take up all the lighting load for this new station as new plant is required, and ultimately to supply power exclusively from the old station.

The site of the new station at Avonbank is almost ideal for the purpose. It is well within the supply area, but yet sufficiently far from the residential district to ensure no trouble on account of smoke and steam, and it is bounded by railway lines and the Feeder River. Adjoining the works is a small colliery.

The building resembles a warehouse when viewed from a short distance. Its design is strictly utilitarian, and its main features are four red brick walls with practically no relief, and a glass roof. The interior is not of artistic appearance either, but is very light. The walls are lined with white glazed bricks to a certain height above the ground, and the large glass roof lets in plenty of light.

One of the most interesting parts of the works is the coal-conveying plant which is of the C. W. Hunt Company's make. Combined with the Hunt chain bucket conveyer is a gravity conveyer to carry the coal from the weighing machine above the barge to the hopper which feeds the chain of buckets. The general arrangement of the conveyer plant is shown in Fig. 5. The coal after being lifted

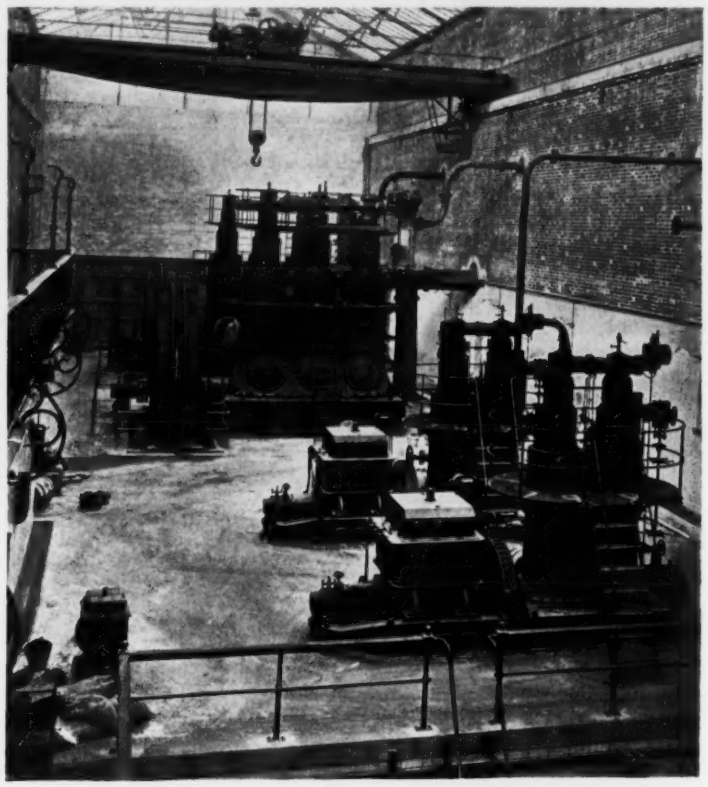


FIG. 2.—ANOTHER VIEW OF BRISTOL PLANT ENGINE ROOM.

up out of the barge to the automatic weighing machine is delivered to the car of the Hunt gravity conveyer or "automatic railway," and the car moved by gravity down the incline track and tips its load of coal into the hopper feeding the chain conveyers. Before

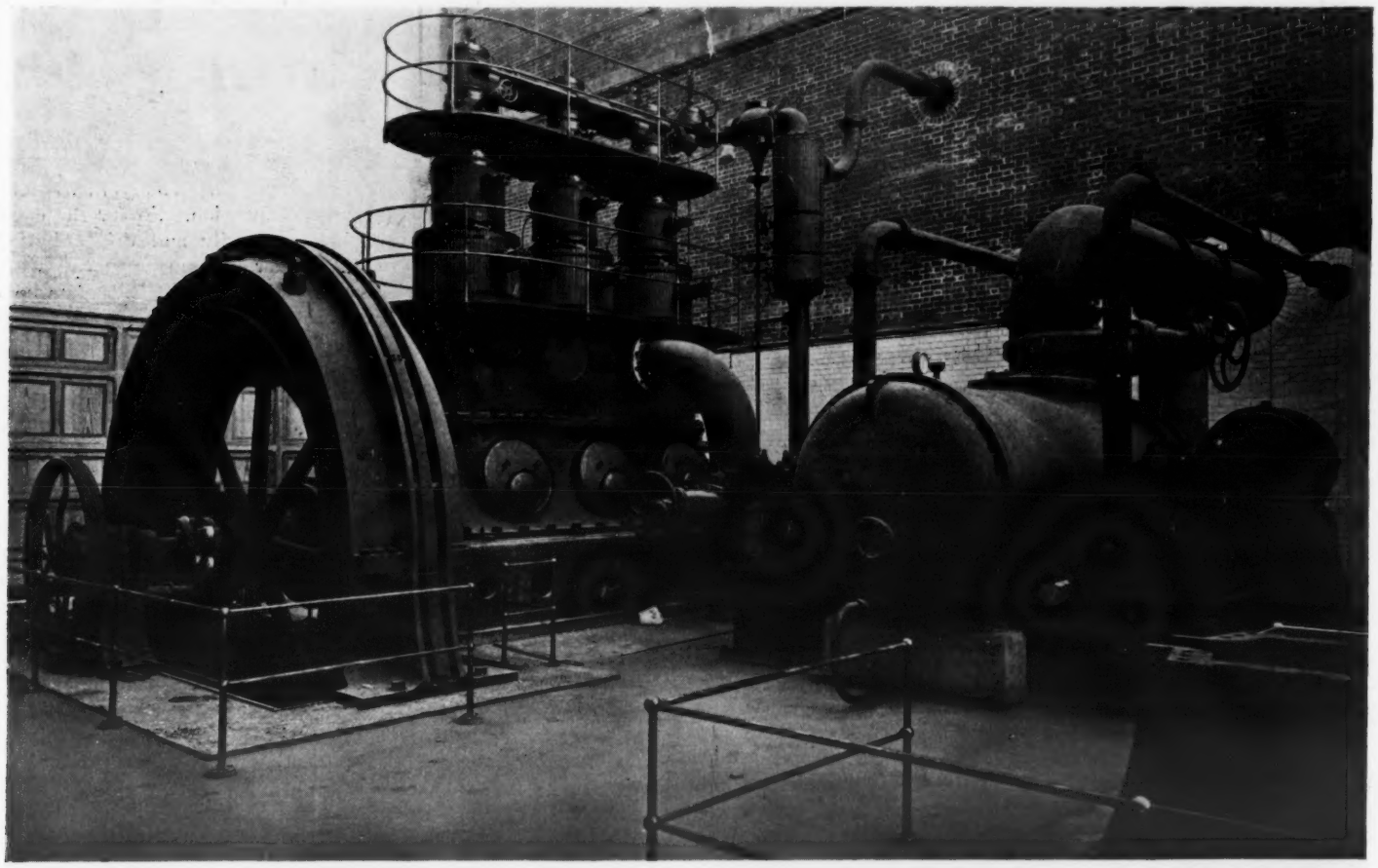


FIG. 1.—A CORNER OF THE ENGINE ROOM, BRISTOL PLANT.

reaching its destination, however, the car picks up a cable and lifts a weight. Part of the kinetic energy of the car is thus utilized and stored in the weight, and when the coal has been discharged and the car is lighter, the weight falls and carries the car back to the starting place above the barge. The weight only hauls the car a certain distance over the track, the momentum gained being sufficient to carry it the remainder of the distance. One man only is needed to operate the railway. He starts the car when filled, but

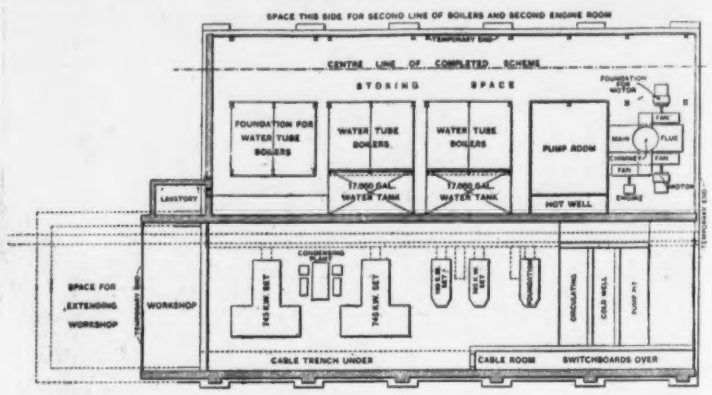


FIG. 3.—PLAN OF STATION.

does not accompany it. The car makes a trip of 300 feet, dumps its load and returns in about 35 seconds.

The gravity conveyer delivers the coal into an elevated steel hopper placed near the gable end of the boiler house. There is a second hopper fixed with its upper edge level with the ground and into this a chute from the upper hopper delivers. This is arranged so that should it be necessary to bring coal in by carts they can tip into the lower hopper. On the mouth of this lower hopper there is fixed a regulating valve which controls the flow of coal into the mechanical filler of the ordinary Hunt bucket conveyer. This conveyer carries the coal to the top of the boiler house, and passes over the coal bunkers for their entire length. Dumping cams and levers are fixed at intervals over the bunkers, by which the buckets are tipped and the coal discharged. The conveyer then passes down at the opposite end of the boiler house and travels along the basement, and, in order to provide depth for the lower coal-receiving hopper already mentioned, the conveyer dips down, as it once more leaves the boiler house and passes into a pit in which the mechanical filler is placed and coal is received.

Provision is made for retrimming the coal in the bunkers, should it be necessary to take it from one part of the bunker and dump in another part. This is done by carrying 12-in. diameter steel

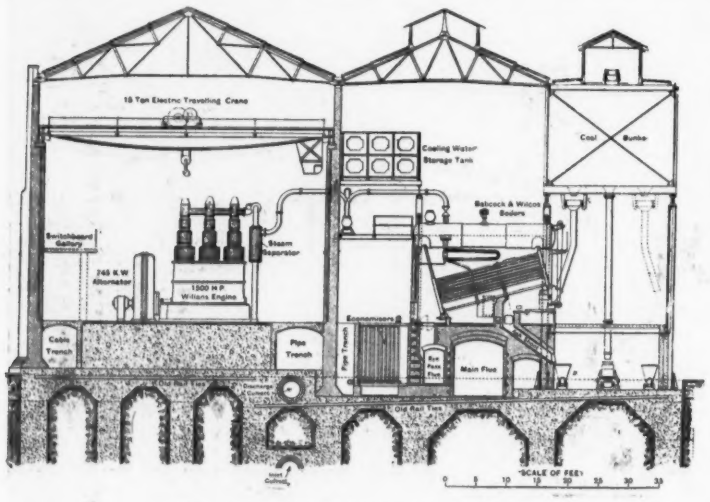


FIG. 4.—CROSS-SECTION OF STATION.

pipes from the bottom of the bunkers through the boiler house floor, and into the basement along which the conveyer runs. These pipes terminate with balanced double-jaw valves, and a rotary mechanical filler travels on a rail track, and can be brought under each of these valves to receive coal and fill the conveyer buckets. The coal can thus be carried up over the bunkers again and dumped where required.

The conveyer is driven by a Siemens semi-enclosed 10 b. h. p. electric motor, but it is estimated that only 6 to 7 b. h. p. will be required to drive the whole of the conveyer plant when raising 40 tons of coal an hour. It is unnecessary to describe the chain buckets in detail, as they are known to our readers. Buckets of fairly large size are employed, and the speed is 35 ft. per minute.

The boiler room contains at present four Babcock-Wilcox boilers, with superheaters, Scotch furnaces and Meldrum automatic stokers. A steam pressure of 200 lb. per square inch is employed. As noted on the plan of the works, the idea is, when extending to double the boiler room and build a second room on the other side of it and both old and new engine and boiler rooms can be extended longitudinally.

An interesting feature in the works is the system of induced draught employed. The chimney is only 70 ft. high, and of steel. A fan engine is located at the bottom of the chinmey, fan chamber beneath it, the speed being regulated automatically by an ingenious device in such a way that, when the boiler steam pressure rises, the speed of the fan engine drops, and when it falls again the engine is speeded up. This automatic steam regulator is composed of a flattened steel tube similar to those used in steam traps, and the varying pressure inside the tube causes it to expand or contract, the action resembling that of a Bourdon pressure gauge. The throttle valve spindle is attached to the end of the tube and is controlled by its position. There is an adjusting spring and screw to regulate the opening of the valve to the desired point. Thus, with an increase of boiler pressure, the steel tube expands and so partly closes the throttle valve on the engine, and its speed and that of the fan is reduced, the supply of air to the boiler furnaces is reduced and a further rise in steam prevented. Each of the fans and engines were tested, and passed 97,000 cubic feet of air per minute each at 2½-in. water pressure. The water consumption during the three hours' test came out at 21.5 lb. of steam per indicated hp-hour non-condensing, and 19.6 lb. per indicated hp-hour when condensing to 20-in. vacuum.

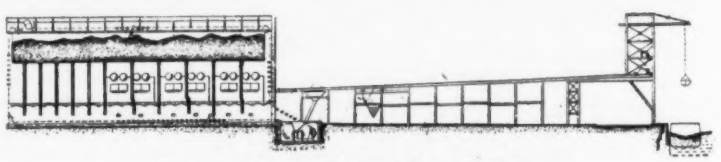


FIG 5.—ELEVATION OF COAL CONVEYOR.

Figs. 1 and 2 are two views of the engine room, one taken from about the level of the switchboard gallery, the other showing one of the large steam alternators and a condenser at closer range. The alternators, of which there will be three, are by Messrs. Siemens Bros. & Co., and, as at the Temple Back station, have revolving armatures and stationary fields. They are rated at 745 kw normal load and 920 kw emergency load. The Willans engines driving them are three-crank triple expansion. So far the exciters have been machines put down temporarily and driven by ropes from the alternator shafts. Whether this arrangement will be adopted or directly-coupled exciters has not yet been determined; the latter are more convenient, but dearer, owing to the relatively slow speed—295 r. p. m. Two continuous-current machines, also Willans-Siemens combinations, supply power at 500 volts for the various motors used on the works, and are also of suitable type for the outside power supply if required at any time. These are 165-kw machines, the engines two-crank and the dynamos two-pole undertype and compound-wound.

Surface condensers are placed in the engine room, and the circulating water is taken from the river and supplied by centrifugal pumps, one of which is motor driven. The make-up feed is taken from the river and softened in a Doulton water softener (probably caustic soda will be used only in this); and the condensed water is pumped through an oil separator on the baffle-plate principle. A Green economizer is also employed.

The steam range is short, as the boilers back the engines. Each boiler delivers into a section of steel main, which is connected to the adjacent one by a wrought-iron bend. At the end of this range is a loop for the feed and circulating pumps, but practically the range may be regarded as single and not duplicated.

There is a crane in the engine room with a capacity of 25 tons.

Ferranti switchboards are employed, located on a gallery in the engine room on the opposite side to the boiler house. These are more or less on the usual Ferranti lines, the chief exception being

that spiral contact plugs are employed. There are two main bus-bars and a "hospital" bus-bar, and the machines are not paralleled directly, but first through an impedance coil with movable core, which is gradually withdrawn. This system has always been in use in the old Bristol station. Provision is made for running the alternators

FIG. 6.—GENERAL VIEW OF COAL CONVEYING PLANT AND STATION.

in parallel with those at Temple Back, but this had not yet been tested.

The two stations are connected together by three 0.3 sq. in., high-pressure trunk mains. These are Siemens concentric paper-insulated, lead-covered and steel-tape armored, laid directly in the ground, armored cable laid in this manner being used throughout in Bristol. Three-core, lead-covered and armored distributors are largely used for the three-wire distributing network. After the cables are laid they are covered with light soil, then common red bricks are placed over them to mark their position, and the trench

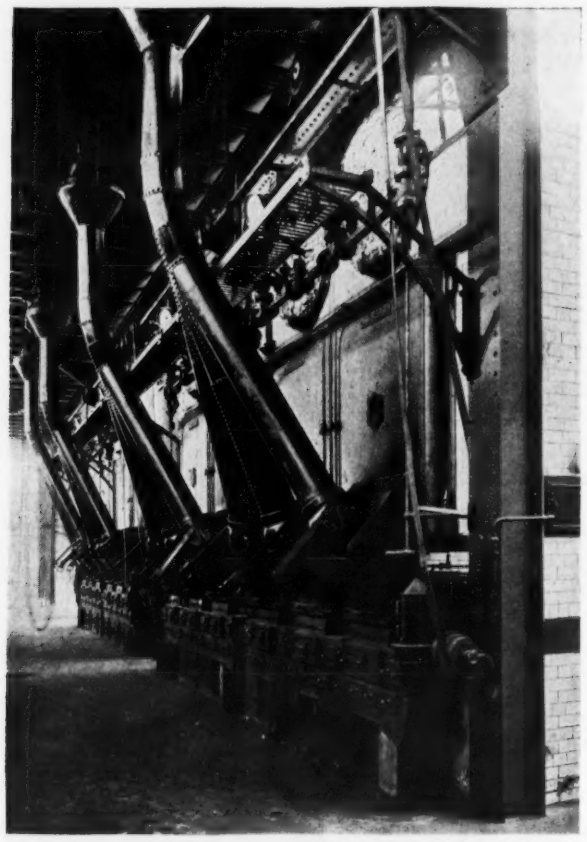


FIG 7.—BOILER PLANT, SHOWING STOKERS.

is filled up. The engineers in charge state that, although the cable system now includes 380 miles of conductors, there have been no more than three electrically-caused breakdowns in it since the works were started, and in nearly all cases the outer jute covering has not perished. In all there are 55 substations in various parts of the district.

Transformer Testing by Central Station Companies.

BY R. F. SCHUCHARDT.

The importance of testing all transformers bought is now so well recognized that almost every very large central station company has provisions for such tests. The object of this paper is to outline the usual tests made, to describe briefly methods of testing which give results of ample accuracy and which are most commonly used, and to give a description of a simple testing table with which some of these tests can be made rapidly. The tests generally made are as follows: 1. Insulation, 2. Resistance, 3. Core Loss and Leakage Currents, 4. Copper Loss, 5. Impedance, 6. Heating.

1. For the insulation test a high potential transformer should be used and the guaranteed voltage applied between coils and core. For a 2,000-volt primary transformer this voltage is generally not less than 2,000 volts between primary and secondary and between primary and core, and 2,000 volts between secondary and core applied for a period of five minutes. The secondary should be grounded on the core when testing between primary and secondary or core; and all primary leads should be connected together as well as all secondary leads, to prevent undue strain in any parts of winding.

2. The resistance of the coils is best measured by the drop of potential method, *i. e.*, by measurement of the volts drop across the coil for a given current, from which the resistance is found by Ohm's law.

3. The core loss and magnetizing current are measured at the secondary. An alternating current of the rated secondary voltage and of proper frequency is applied at the secondary terminals, and an ammeter and a wattmeter are inserted in the circuit to read respectively the leakage current and the core loss watts. The amperes thus found must be divided by the ratio of the transformer to get the leakage current. From the data obtained in this test the no-load power factor is calculated. Care must be taken in making this test to have the primary leads clear, as full voltage will be on the coils.

4. The copper loss can be calculated from the measured resistances ($I_1^2R_1 + I_{11}^2R_{11}$, where I_1 is the primary current including

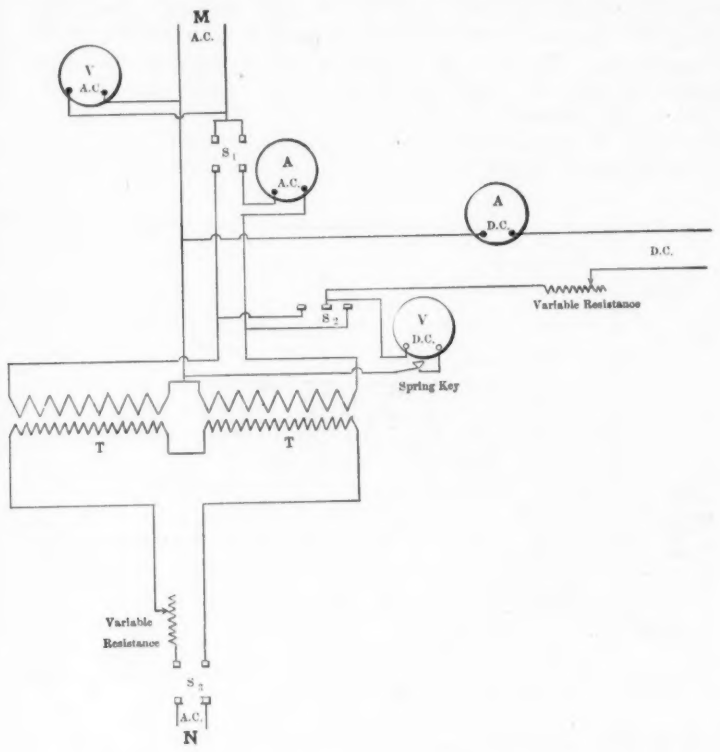


FIG. 1.—DIAGRAM OF CONNECTIONS FOR TRANSFORMER TESTING.

leakage; I_{11} is secondary current; and R_1 and R_{11} are primary and secondary resistance respectively), or it can, with sufficient accuracy, be measured directly in connection with the impedance tests.

5. The impedance test is made as follows: The secondary coils are short-circuited through an a. c. ammeter of negligible resistance, and a pressure of proper frequency is impressed upon the

primary coils, sufficient to cause full load current to flow, or this full load current can be measured on the primary side (neglecting the small leakage current), the secondary coils then being short-circuited direct. The reading of a wattmeter on the primary side in this test will be (nearly) the copper loss at full load, while the voltage represents the impedance drop, and is generally expressed in per cent. of the rated primary voltage. The measured watts include, in addition to the I^2R loss, the core loss at the low voltage used and eddy current loss in copper and iron, which values are,

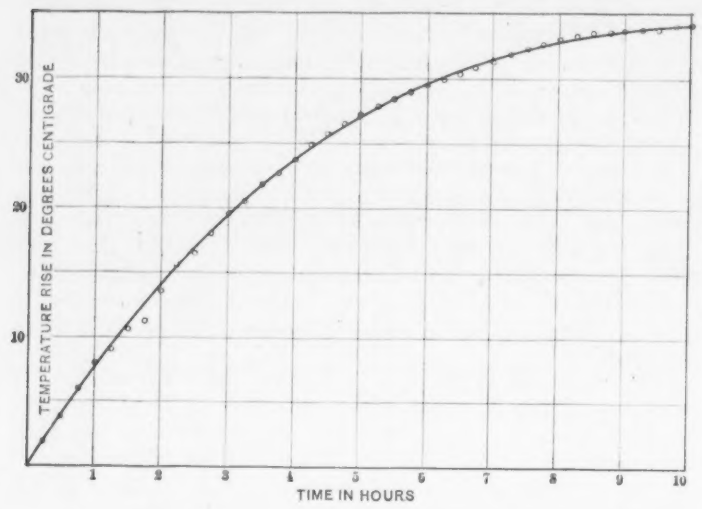


FIG. 2.—TEMPERATURE CURVE OF AN OIL-COOLED TRANSFORMER.

however, so very slight as to be entirely negligible in commercial measurements.

The above-described tests should be applied to every transformer before it is connected to the lines. In addition to this at least two transformers of each capacity in every lot received should be subjected to a heat test. The most satisfactory method to use for this is the one commonly known as the "motor generator" method. Two transformers of like capacity and voltage are tested together. The connections are shown in Fig. 1. The secondaries of both transformers are connected in parallel to an a. c. circuit M of voltage equal to rated secondary pressure, thus supplying from this side the full core loss. The primaries are connected in opposition and an alternating current of voltage equal to the sum of the impedance volts of the two transformers is impressed on the open terminals N, connected as shown. This voltage on the priamries should be adjusted for full loal current in the a. c.

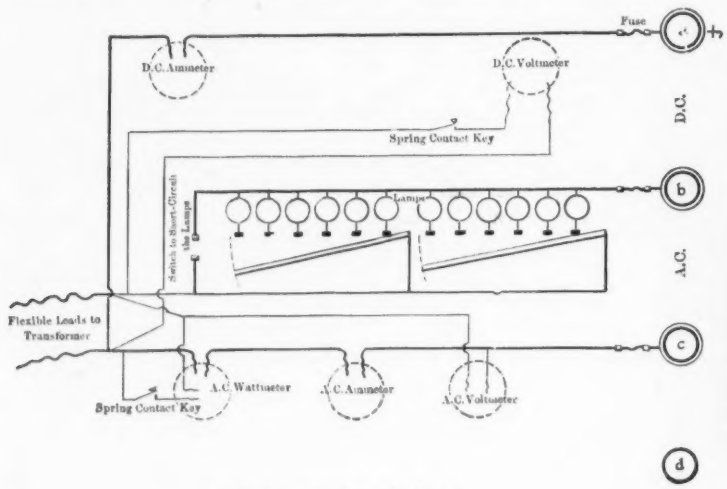


FIG. 3.—WIRING DIAGRAM.

ammeter when switch S is closed, and before pressure is applied from the secondary side. Then, when pressure is applied from both sides, the two transformers are practically under full load working condition. Direct-current connections are made, as shown, through switch S_2. At the beginning of test the resistance of the secondary coils is measured by means of the direct current, thus giving resistance at room temperature. At regular intervals (twenty-minute readings are sufficient) during the test the a. c. switches are opened, S_2 is closed for resistance measurement first on one coil and then on the other. The average temperature of the coils are calculated from these measured resistances, using the equation

$$t \text{ (rise in degrees C.)} = \frac{Rh - R}{0.004\ R}$$

where R is the resistance at room temperature and Rh = resistance when hot. This is the same as dividing the per cent. increase in resistance by 0.004, which figure is approximately the temperature co-efficient of resistance of copper at 25° C. For every 10° above

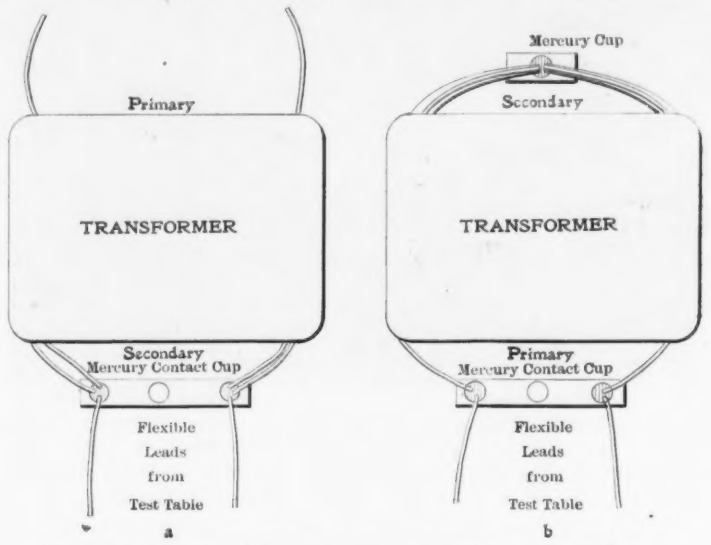


FIG. 4.—CONNECTIONS FOR MEASURING CORE LOSS AND LEAKAGE.

25° C. this co-efficient should be increased by about 1.5 per cent. These measurements should be made rapidly so as not to keep the alternating current off long enough to affect the heat test. The direct current used should be of about the same amperage as the a. c. for full load. The voltmeter key should not be closed until S^2 is closed, in order to avoid injury to voltmeter from the inductive kick. They should also be opened before S_2 is for same reason. S_2 must, of course, remain open when a. c. switches are closed. The leads connecting secondaries to switches and S_2 should be of sufficient size so their resistance will not be appreciable. This

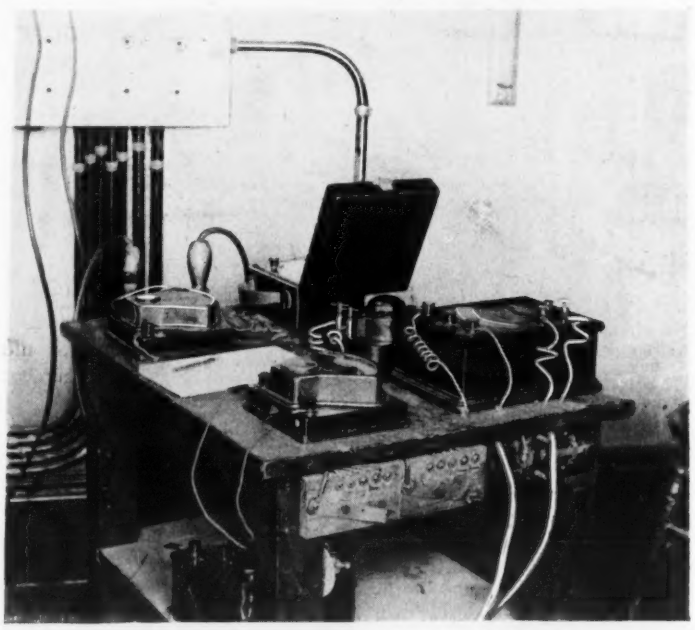


FIG. 5.—TESTING TABLE.

heat test should be continued until constant temperature is reached. which requires about ten hours. From the data obtained the heat curve is plotted.

Fig. 3 shows the diagram of wiring of a table which was designed for making all the tests mentioned above, except those for insulation and for heating. The transformer under test is connected to the flexible leads from the test table through mercury contact "cups," as shown in Fig. 4, in which a shows the connections for measuring core loss and leakage current, and b the measurement of

copper loss and impedance volts. These flexible leads are about 5 feet long, which permits from 10 to 12 transformers being grouped around on three sides of the table and tested without any change except swinging transformer around and moving mercury cups along to each transformer in turn. Thus core loss and leakage current (or resistance) test can be made on all the transformers in a row, the transformers then turned around and, on going back the copper loss and impedance volts (or resistance) can be measured. This arrangement results in a very material saving of time and trouble, especially if the transformers are nearly of the same capacity, in which case the rheostat setting (number of lamps on) will not be changed much for the different transformers. Current is conducted to the test table from a plug board on which are found a. c. (115-v. and 230-v.) d. c., and water rheostat terminals.

Referring to Fig. 3, *a* and *b* are the plug reeptacles on test table, used when measuring resistance (d. c.), and *b* and *c* for all a. c. measurements. *d* is a "dead" receptacle for inserting one of the plugs when the circuit is to be open. All wiring of the table is underneath, except where the leads come through the top for meter connections, and is of ample size so the *IR* drop is in it is negligible. A sheet of asbestos covers the wiring to protect it from the heat of the lamps, which are arranged horizontally along the sides of the table under the top. In measuring the secondary resistance of transformers the drop in the flexible connecting leads will be an appreciable amount of the voltmeter reading, and must be taken into account. The resistance of these leads can readily be determined by inserting the ends of both leads in the same mercury cup and with two primary or two secondary coils to have the coils measured in series if so desired. These mercury cups are holes bored into the side of a block of wood nailed upright to a base board. They are about 8 inches high.

The table described here has been in use for more than two years and is found very satisfactory. Fig. 5 is a photograph of the table with all meters connected ready for test. By closing the switch which short-circuits the lamps, the table can be used for testing motors up to the capacity of the wiring.

The *meters* best suited for testing transformers of capacities ranging from 1 kw to 30 kw with primaries not over 3,000 volts, are as follows:

1 direct-current ammeter with two scales, 0 — 1 and 0 — 10 amperes.

1 direct-current voltmeter with three scales, 0 — .15, 0 — 1.5, 0 — 15 volts.

1 alternating-current voltmeter, 0 — 150 volts.

1 alternating-current ammeter, 0 — 2 amperes.

1 alternating-current ammeter, 0 — 15 amperes.

1 alternating-current wattmeter, 2 amperes, 150 volts, scale, 0 — 300 watts.

1 alternating-current wattmeter, 15 amperes, 150 volts, scale, 0 — 1,500 volts.

An additional wattmeter for 5 amperes and 150 volts, with scale 0 — 750 watts, is very desirable, though not an absolute necessity. The d. c. ammeter is preferably a meter with separate shunt. It should be ordered for the proper shunt ranges and for a full scale

Make	Number	Type	Capacity in Watts.	Ratio of Transf.	Date of Test	Pri. Res. Coils in Series	Sec. Res. Coils in Par.	Impedance Drop. Per cent.	Copper Loss Watts.	Core Loss Watts.	Leakage Current	P. F. at No Load Per cent.	Regulation Per cent.	Full Load Efficiency Per cent.	Room Temperature Deg. C	Remarks
x x x	x x x x x	x	1,000	2080/1040 = 115/230	4-15-02	79.0	.1352	4.9	31.0	30	.0222	65.0	3.04	94 25	23	
			1,500	" "	"	44.1	.0906	3.6	41.0	35	.0259	65.0	2.75	95.18	23	
			2,000	" "	"	35 0	.0591	3.7	53.0	45	.0332	65.0	2.60	95.33	23	
			2,500	" "	"	24.0	.0490	4.0	60	50	.0370	65.0	2.38	95.79	23	
			3,000	" "	"	18.0	.0440	3.9	70	56	.0414	65.0	2.32	95.97	23	
			4,000	" "	"	14.4	.0300	3.8	92	65	.0480	65 0	2.28	96.24	23	
			5,000	" "	"	10.6	.0200	4.1	102	74	.0547	65.0	2.06	96.60	23	
			7,500	" "	"	6.50	.0156	3.7	150	100	.0740	65.0	2.00	96.78	23	
			10,000	" "	"	4.61	.0114	3.4	192	130	.0960	65.0	1.92	96.88	23	
			15,000	" "	"	3.04	.0078	3.6	296	165	.1220	65.0	1.98	97.00	23	
			20,000	" "	"	2.01	.0059	3.5	365	190	.1405	65.0	1.95	97.02	23	
			25,000	" "	"	1 72	.0048	3.4	480	210	.1554	65.0	1.93	97.32	23	
x x x	x x x x x	x	30,000	" "	"	1.38	.0035	3.4	525	250	.1850	65.0	1 77	97.48	23	

FIG. 6.—DATA OF TRANSFORMER TESTS.

measuring the voltage drop for a given current. If No. 6 wire is used, this resistance will be about 0.004 ohms. The leads to the d. c. voltmeter should be of same resistance as the regular leads belonging to the meter used, and the spring contact key should be kept clean. If the d. c. voltmeter has a low resistance its current must be substracted from the indications of the ammeter to get accurate results. The a. c. voltmeter connection should be open when the d. c. readings are taken, as this meter is in shunt with the transformer coil under measurement.

In measuring leakage current the wattmeter pressure circuit is left open while the ammeter is read, and then closed by depressing spring key for measuring core loss. For copper loss measurement the ammeter is brought to the correct primary full load, with wattmeter pressure circuit open, and the voltage is read. The wattmeter reading is then found for the same voltage. The connections of the wattmeter pressure wires, as shown in Fig 3, are for meter which has a compensating coil for the pressure circuit current. For wattmeters without this compensating coil the pressure connection should be made on the other side of meter. As mentioned before, the leads are of ample cross-section so the small *IR* drop in them will be well within the accuracy of the meters as read. Therefore, for commercial measurements no fine corrections need be applied. In addition to the lamp rheostat (which contains lamps of various cp) a water rheostat with terminals on the plug board is found a great convenience for accurate adjustments. In Fig. 4 one of the mercury contact blocks is shown with three "cups." This is to permit of transformers deflection of the meter itself, with its leads on 100 millivolts. This latter condition can be obtained from the manufacturer without additional cost, and it practically adds another useful meter to the equipment of the testing department. It will also be found useful to have a second scale, reading 0 — 300, on the a. c. voltmeter, and have the wattmeters provided with pressure coils for both 150 and 300 volts. It is, of course, needless to emphasize the necessity of keeping all meters in accurate calibration.

The data obtained in the tests outlined above should be recorded in some such form as shown in Fig. 6, except that a separate sheet should be used for each capacity of transformer so the results can be easily compared. The figures given in the table, Fig. 6, are approximately average values representing good modern manufacture. The values given under the heading "Regulation" are for non-inductive load and are calculated from the following formula:

$$Reg. = \frac{Copper\ loss\ watts}{Total\ input\ watts} + \left(1 - \sqrt{100^2 - \%\ Imp.\ drop^2}\right)$$

For example, take the 2,500 watt transformer in table of Fig. 6. I^2R loss = 60 watts or 2.3 per cent. of the input. Drop due to impedance $1 - \left(\sqrt{100^2 - 4^2} = 0.08\%.\right)$ Regulation for this transformer is, therefore, 2.38 per cent. To facilitate rapid calculation of this value a curve plotted between "impedance drop per cent" and $(1 - \sqrt{\quad})$

or per cent. regulation due to impedance, will be found convenient. Fig. 7 shows such a curve, with impedance drop per cent as ordi-

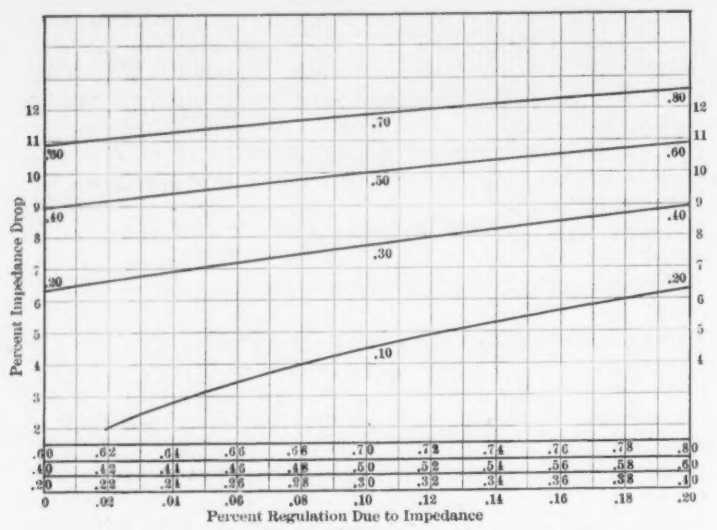


FIG. 7.—PER CENT REGULATION DUE TO IMPEDANCE.

nates, and per cent. regulation due to this drop as abscissa. The several lines of this curve are the continuations plotted above the

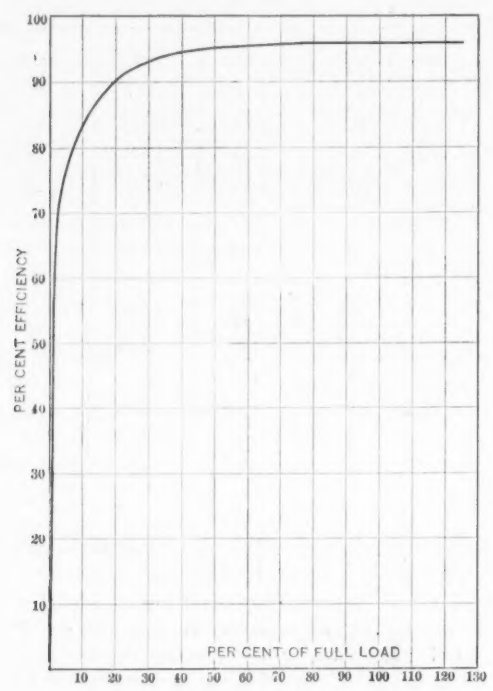


FIG. 8.—EFFICIENCY CURVE.

first part in order to obtain the curve in compact form. The calculated values from which the curve is plotted are as follows:

Impedance. Drop. %	*Regulation due to Impd. drop.* %	*Impedance. Drop.* %	*Regulation due to Impd. drop.* %
2	.01900	7.5	.28125
2.5	.03125	8	.32100
3	.04500	8.5	.36325
3.5	.06125	9	.40625
4	.08000	9.5	.45250
4.5	.10200	10	.50000
5	.12625	10.5	.55150
5.5	.15020	11	.60700
6	.18100	11.5	.66750
6.5	.21200	12	.72250
7	.24500	12.5	.78500

CALCULATED DATA FOR EFFICIENCY CURVE.

Load in Watts.	Pri. Cur. (including leakage.)	Sec. Current.	Pri. I^2R. loss.	Sec. I^2R. loss.	Total loss, Copper loss and Core loss.	Imput Watts.	Efficiency.
250	.157	2.174	.59	.23	50.82	300.82	83.1
625	.337	5.435	2.73	1.45	54.18	679.18	92.0
1250	.637	10.870	9.75	5.78	65.53	1315.53	95.0
1875	.937	16.305	21.08	13.08	84.16	1969.16	95.72
2500	1.237	21.740	36.6	23.2	109.80	2609.8	95.79
3125	1.537	27.175	56.5	36.1	142.6	3267.6	95.64

The efficiency curve of the 2,500 watt transformer of the table is shown in Fig. 8. The above data show the necessary calculated values for this curve.

The Field of Force in Wireless Telegraphy.

BY LEE DE FOREST.

FROM the time when public attention was first drawn to experiments in space telegraphy by means of Hertzian waves, speculation has been rife as to the *modus operandi* of the transmission. Numerous theories, many vague, more fantastic, have been advanced, and remarkable when the array of facts which directly and clearly contradict them are considered.

Thus a French writer was early to assert that these oscillations traveled and returned in earth strata of differing conductivity; although a countryman of his demonstrated very clearly that a few feet of damp earth was completely opaque to such vibrations. The theory of transmission through an electrically stratified atmosphere has found its adherents—and one experimenter who figured prominently in Marconi's early work, suggests, in explanation of the earth's influence in transmission, that by charging and discharging the sending antenna we merely alter the electrical density of a point on a sphere. The induction and conduction theories have also been advanced.

Naturally the wave theory has had numerous champions, but with surprising disregard for the actual phenomena. Thus, in early days, when Lodge and Marconi repeated Hertz's classifical work with parabolic reflectors, and straight line propagation was obtained, the exact analogy between these "wireless" oscillations and those of polarized light was asserted. The analogy has been clung to generally and persistently ever since; and this notwithstanding the remarkable effects obtained from grounding the sending instrument, the marked difference in transmission over land and sea, the failure of obstacles to obstruct, the strange falling off in transmission during very hot weather, et cetera.

In 1899, when Marconi first transmitted signals over a hill of water completely shielding his two antennæ, the failure of the light analogy to explain was equally convincing as on December 21st last; yet it required transmission over an eighth of the globe to show some that these strange oscillations were not exactly like light waves, and did not travel in straight lines. Only last summer an eminent American physicist asserted the impossibility of transmitting signals where the curvature of the earth intervened.

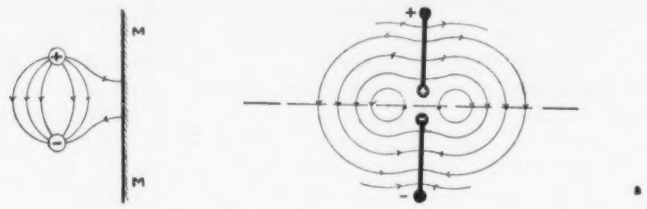
Much of this misunderstanding and false work might have been prevented had attention been more widely drawn to a paper which appeared in May, 1899, in the London *Electrical Review*. Its author, Taylor, there sets forth, I believe, for the first time, the ground work of a theory which seems capable of explaining most of the transmission phenomena thus far observed by workers in the wireless field. Several scientists have gone more deeply into the same theory, notably Blondel and Abraham, and there exists already some mathematical work on this fascinating and highly important subject.

The theory is briefly this: The oscillations employed in "space" telegraphy are truly Hertzian waves, not static disturbances, not induction currents; radiated outwardly from the upright conductor, yet not pure space radiations. The radiator may be regarded as half of the familiar Hertz oscillator, and the waves sent out as very analogous to the *waves* on *wires* first investigated by this distinguished savant. They are more exactly waves traveling over the surface of a conducting plate. If this be a perfect conductor

(and over sea the analogy is sufficiently maintained), the field of force is very similar to that plotted by Hertz from his dumb-bell oscillator, but cut in half by this reflecting, conducting surface, in its equatorial or plane of symmetry.

The spark-gap lies nearest this plane and one terminal is grounded thereto. Assume that the antenna (corresponding to the upper arm of the oscillator in Fig. 2) is positively charged. The opposite negative charge is found on the surface of the earth in its vicinity, and we have the static lines of force extending from the antenna to the conducting surface, somewhat as shown in the figure.

During disruptive discharge and the rush of positive charge to earth, these force lines will spread out; their upper and inner ends may be regarded as running down the surface of the antenna into the



FIGS. 1 AND 2.—FIELD OF FORCE IN WIRELESS TELEGRAPHY.

earth; their higher curved portions traveling outward and upward, expanding exactly as do the lines of force from the dumb-bell oscillator. A portion of the electrostatic wave is thus entirely detached from the antenna, but with both ends of each line of force grounded, and slipping outward over the surface of the earth. The upper portions go on expanding, increasing in altitude, attenuating, but also traveling outward from the axis of the antenna.

Another portion of the original static energy, larger or smaller as the oscillating system is less or more strongly damped, re-enters the antenna at the spark-gap, changing into electromagnetic energy or current, to provide the following oscillations of the wave-train.

During the next half period, the oscillation traveling upward on the surface of the antenna, is reflected at its top without change of static sign, giving an electrostatic loop at this free end, while a corresponding loop of the electromagnetic standing wave exists at the base or one quarter wave length distant.

The detached or radiated wave takes now the form shown in sectional planes in Figs. 3 or 4, the directions of displacement currents being as indicated. Since, however, the earth is never a perfect conductor we have not a pure transverse wave. These static lines are not entirely perpendicular to the surface at their bases; there is a tangential component, larger in the case of transmission over land than sea.

The electromagnetic lines of the radiating wave are in ever-widening circles, concentric with the antenna. Hertz has shown how to separate the effects of the electrical and magnetic components in waves along wires; and that even here the two are of the same order of magnitude in their mechanical effects. The limiting condition

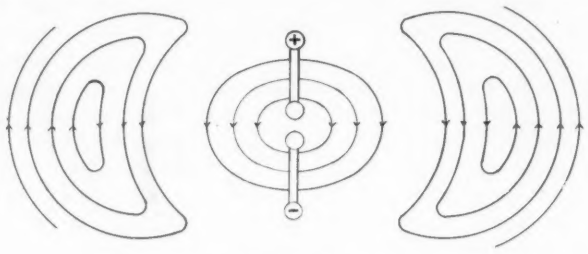


FIG. 3.—SECTIONAL PLANES OF WAVES.

as to when this relation begins is that of true dielectric waves, of so high a frequency as to travel in the skin of the (perfectly conducting) wire alone, giving us a conductor inside a train of waves. As the wire approaches infinite thinness the magnetic component comes into prominence. On the other hand, the broader the surfaces attached thereto the more is the magnetic force overpowered by the electric.

So here, even in transmission over sea water, practically opaque to oscillations of the order of millions per second frequency (*i. e.*, an excellent conductor for them) the electromagnetic energy is but a small portion of the energy of the wave; what there is of it lies largely in the equatorial region, nearest the surface. There, too, it is most certain of obstruction, being absorbed in Joulean losses in conducting obstacles. Blondel, in direct opposition to this view, states that the electrostatic lines radiated from the antenna go rapidly to earth, and that transmission at a distance is, in consequence, by the magnetic components. The correctness of this assumption, however, is not at all borne out by experiments in the upper atmosphere, such as those to which we shall presently refer.

By this modern "Taylor's theorem" then, many puzzling facts in wireless are explained. Here we have our electrostatic waves, plane polarized, but "grounded" traveling outwardly from the antenna in all horizontal directions alike, with a velocity approximating that of light, crests separated by a distance twice the height of the upright wire; the base of the waves following the curvature of the earth, traveling over hills of conducting material if these are not steep

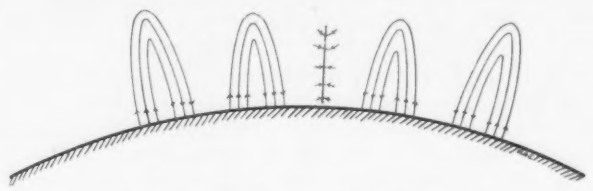


FIG. 4.—SECTIONAL PLANES OF WAVES.

relative to the wave length, or absorbed by such if precipitous; as well as by trees, steel masts, cordage, building frames, etc.; and passing *through* similar hills and obstacles if of a non-conducting nature.

If over dry soil the equivalent conducting surface may be indeterminant in location, lying at depths varying to several hundred feet below upper earth, with the crests of the waves correspondingly depressed.

Thus is made clear the strange effects observed over various qualities of country and under differing conditions apparently so puzzling. For example, Prof. Fessenden reports that it required seven times as much power to transmit signals over 47 miles of frozen earth as was needed over the same range after a thaw. Ice, of course, is a splendid dielectric to electric oscillations of such frequencies.

Again, over dry, arid land, transmission is always poor, as it is also over heavily wooded country, especially in the spring and summer. It is best over low, marshy stretches where vegetation attains no great height.

The grounded radiating wave will tend to follow and concentrate upon that path affording greatest conductivity. Thus Prof. Slaby found that a loose wire laid along the ground between his two instruments considerably improved the transmission, while a similar one under water allowed no such effect. Hence in the same way the earth will tend to absorb energy waves, whose lines of electric displacement are parallel thereto, and thus arises the necessity for vertical rather than horizontal antennæ.

In connection with this maximum conductivity path, it may be expected that the grounded wave will follow the course of a river, even if tortuous, in preference to straight line transmission over land. No data on this point has yet been reported, but experiments are shortly to be carried out to determine this interesting question.

As Hertz first pointed out, the energy of his wave decreases with the sine of the angle between the vector leading from a point on its surface to the spark-gap, and the axis of the oscillator. Hence, the chief electrostatic energy also resides nearest the equatorial plane, at least over water where obstacles have not too far consumed the same.

Very interesting in this connection are the experiments which have been made with receiving instruments attached to the upper ends of wires suspended from balloons, at various distances from the sending antenna and at different altitudes. Thus Le Carme in his observations among the Alps obtained signals from a 50-meter wire suspended 600 meters directly above a similar upright on the earth's surface, showing that the same did not give off a purely transverse wave. By Hertz's theory this axial line was that of least radiation of energy. But when 6,000 meters from the sending wire Le Carme reports signals obtainable at a greater height, 800 meters, thus illustrating the upward expansion of the wave which accompanies its outward radiation.

Captain Ferrie has also investigated this distribution of the Hertzian field in the atmosphere. He used for sending antenna a conductor 50 to 100 meters length, supported by a balloon; and for receiving one of 50 to 200 meters, suspended from a large captive

balloon capable of rising to a height of 800 meters, and containing the receiving instrument.

When the sending antenna was 100 and receiver 200 meters in length, and 20 kilometers distant, the receipt of signals was equally good in all altitudes up to 800 meters. By reducing the length of receiving wire one-half he found 400 meters altitude as the upper limit. Other experiments showed that signals could not be obtained with his apparatus at heights between 800 and 1,000 meters, at the distance named.

In this connection it is of interest to note that the best effects were obtained here when tne receiving wire was twice the length of the sending upright. This was to be expected, inasmuch as the one was a freely oscillating, unearthed system; the other grounded and representing but one-quarter wave length. From such observations is made clear the role which the earth plays in transmission in preventing the dispersion of the field into space—another instance of Nature's mercifulness to man.

It has been frequently observed that during mid-day hours in extremely warm weather wireless transmission for great distances is practically impossible. Thus in the French experiments between Biot and Calvi communication was practically suspended between 10 and 11 A. M. Such facts have been explained by the light wave, rectilinear-transmission theory, as due to refraction from the rarefied gas nearest the earth's surface. If the feet of our lofty lines of displacement are well grounded, why should this rarefied strata offer an obstruction?

Several continental physicists have determined, however, that air of only slightly diminished density is a practical conductor, even to such relatively low frequencies as we have in wireless telegraphy. This means that the rarefied layer lying nearest the water will take upon itself the role of conducting surface, and our electric wave will, therefore, travel over head and out into space. We should, therefore, expect to find such experiments as those of Le Carme and Ferrie successful at higher altitudes during heated periods than at other times.

Consider now the sending apparatus, using merely a capacity instead of ground connection. The reason that long-distance transmission is never accomplished by such arrangement is evident; but the influence of the earth as a conducting medium still exists, though diminished. If, as in Fig. 1, we have two oppositely charged bodies, and near them a conducting plane *M M*, a portion of the lines of static displacement will run into the conductor as shown. When a discharge occurs between the two bodies all of the lines of force will not be sent off self-closed, but a portion will travel over or into the sheet *M M*. Thus if the capacity at base of the spark-gap lies in the vicinity of earth and the system be set into sufficiently rapid oscillation relative to its dimensions, we will still have to a certain extent transmission over the conducting surface. A large portion of the lines, however, being self-closed will radiate rectilinearily into space, or be actually reflected from the earth's surface.

When the advancing wave train encounters any conducting obstacle, sections of the lines of displacement composing such wave are cut out of it, as it were. The obstacle, if large relative to the wave length, will cast an electromagnetic shadow, but where the wave length is of several hundred feet an ordinary upright conductor, owing to the phenomenon of diffraction, will not essentially shield another situated a little behind it. As Heavisides has so well illustrated, the lines of the displacement wave advancing in a direction normal to their length will cut into a metallic conductor in their path, and entering therein in directions nearly perpendicular to the surface of the conductor, will, therefore, travel up or down the same, as the wave advances. This action means merely the excitation in the skin of the conductor of actual conduction currents, of the same frequency as that of the exciting oscillation; or if this be strongly damped, or a periodic, the single impulsive charge will cause the conductor to discharge or oscillate at its own natural period of vibration. Thus the action upon the receiving upright is inductive, though not in the ordinary interpretation of the word. This, being a volume effect, would vary as the inverse cube of distance, while were the action due simply to the static charge upon the top of the sending antenna, the law would be that of the inverse square; if from the wire, as the first power of the distance, as actually tested in the laboratory. Lietz, using as receivers a Klemencis thermo-element and Ruben's balometer, has found this law to be intermediary between the two. On the other hand, the inductive effects from the two forces increase as the square and the first power respectively of the intensity of the source.

Ascoli, reasoning from Neuman's formula, has shown that the mutual action between the two single antennæ should vary directly as the product of their heights, or, if equal, as the sqare of one; and inversely as the distance apart. Much data from the field corroborates the correctness of this law, making due allowance for the extra increase of range arising from better transmission over obstacles of the longer wave lengths.

With an antenna arrangement as shown in Fig. 5, the quarter wave length may be greatly increased, but there is also the liability of harmonics, or multiple vibrations from the antenna as a whole and its component parts. If its electromagnetic pulsations be too slow, they are unaccompanied by any alternating static field, and do not emit radiant energy; the waves are not detached from the conductor, there is no Hertzian decrement of damping, and any action at a distance is by simple induction.

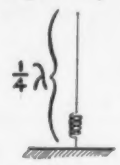


FIG. 5. ANTENNA ARRANGEMENT.

Sufficient figures have not yet been reported to establish a general law as to the relation between actual range in the field and length of spark-gap or potentials. The connection between these latter is by no means as simple as it might appear, largely because of the changes in wave front and length of wave train introduced by alternations in the nature of the spark-gap.

Spokane-Coeur D'Alene Water Power Plant.

A large addition is to be made to the plant of the Washington Power Company, of Spokane, Washington, which when completed will make the plant one of the largest in the West. The new building, including the present one, will be 115 x 120 feet, and furnish 13,800 square feet of floor space, to which will be added a switchboard gallery on the west end. The hydraulic machinery will be installed in the new portion, and will be supplied through two steel pipes 10 feet in diameter. The present dam will be largely extended. The addition of these two new pipe lines will give the company five lines, two of the pipes for the present plant being 9 feet in diameter, and one 10 feet. The latter pipe, however, has only been thus far used on special occasions when the others were under repair.

Near the new building will be erected a standpipe 66 feet high, which will be connected with the two new lines, in order to regulate the water pressure. The pipes will supply two large turbines capable of developing each 4,000 hp. The turbines will be direct-connected to the shafts of two generators having a rated capacity of 3,000 hp, and each capable of developing 4,000 hp. A new switchboard of blue Vermont marble will be erected on the gallery and occupy the whole end of the building. From this gallery the operator will be able to observe the entire plant.

The company expects that all work on the new dam, the pipe lines, standpipes and building will be completed by Jan. 1, 1903. Surveys for the pole lines between Spokane and Cœur D'Alene will be finished in a couple of months, and the conductors erected during the fall. All the machinery has been ordered and will be on the ground by fall. The new generators will each weigh about 45,000 lbs. and stand 12 ft. high. A 20-ton crane will be erected in the generating room.

The hydraulic extension will give a head of 70 feet, which will render available at least 20,000 hp; by going up to the upper level of Spokane Falls, 30,000 hp could easily be secured. The company expects to transmit power to the Cœur D'Alene mines, where most of it will be used in the operation of pumps, compressors, crushers, concentrators and other mining machinery; also for lighting the Wardner, Wallace, Burke and other mines. The pole line to Cœur D'Alene will be about 100 miles long. This line will also furnish power and light for intermediate towns or mines. About 1,000 hp will be used for arc lighting in Spokane.

Wireless Telegraphy to Block Island.

It is reported that a wireless telegraph system will be operated between Providence and Block Island, R. I. Negotiations have been entered into for the purpose by the American Marconi Company.

Synchronous Motor Calculations.

BY F. G. BAUM.

THE constantly recurring questions coming up when we operate synchronous motors, especially on a transmission line, makes it desirable to have some simpler method of solving synchronous motor problems than those generally used. The method here given will, I believe, commend itself to busy engineers who have to deal with the question.

The great difference in the amount of mental and physical effort required to solve a given problem concerning the electric generator and one concerning the synchronous motor would lead us to suspect—since the motor may be regarded as the inverse of the generator—that there is a simpler way of solving synchronous motor problems than the one commonly used. In the electric generator we always have three pressures to consider. (1) The generated pressure, (2) the terminal pressure, or the pressure at some point on the line, and (3) the pressure to overcome the synchronous impedance of the generator and the line. These three pressures always so related as to form a closed triangle. In the synchronous motor we have, similarly, three pressures to consider. (1) The back e. m. f. of the motor, (2) the impressed pressure at the terminals of the motor, or the pressure at some point on the line, and (3) the pressure to overcome the impedance of the motor. These pressures are also so related as to form a closed triangle. We have exactly similar terms to consider in each problem, which makes the simplicity of generator calculations and the complexity of synchronous motor calculations surprising. The difference must de due to the method of attacking the synchronous motor problem. I will attempt to show in this paper that it is as simple to solve any problem concerning a synchronous motor as it is to solve any problem concerning a generator.

Figure 1 may represent a generator or motor. The synchronous reactance, x_0, and the resistance, r_0, of the generator or motor may be considered as connected outside, leaving a perfect generator or motor, developing a pressure E_0. The pressure E is the delivered pressure by the generator, or is the pressure applied to the motor. (If E is not at the terminals of the motor or generator the reactance of the line must be added to the synchronous reactance, and the resistance of the line must be added to the resistance of the generator or motor). E^1 is the pressure consumed by the impedance between E and E_0. E_0 is the pressure developed by the generator or the back e. m. f. of the motor.

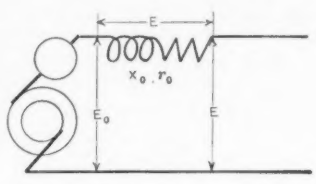


FIG. 1.—GENERATOR OR MOTOR.

The measurable quantities which may be determined by direct measurement in the case of a generator are the terminal pressure, the current and power delivered, from which the power factor may be computed. The value of E_0 and E^1 may be indirectly determined, E_0 from the excitation, and E^1 by calculation from the current and the impedance. The important quantities in the case of the generator are the terminal pressure, the current and power factor at terminals. Knowing these and the synchronous impedance, the value of E_0 for any load and any power factor may be determined in several ways.

In the synchronous motor, the measurable quantities are the same as above, the important quantities being again the impressed pressure, the current and power factor. For a given input into the motor, the current supplied will depend on the excitation; conversely, in the generator the excitation for a given load depends on the power factor of the load. The determination of the excitation so that the power factor at a given load shall be a certain value is not as easy, however, as the determination of the excitation for a given load and power factor in the case of the generator. It will here be shown that one problem is as easy of solution as the other. Let us first obtain a diagram showing the value of E_0 for the case of a generator for *any load* and *any power factor*.*

When we have receiver loads of different power factors, we get simpler results if we consider the total current delivered by the generator divided into two parts: (1) The power component, and (2) the wattless component, and regard each as flowing separately over the impedance of generator and line. If I is the total receiver current and θ the angle of lag of the receiver current behind the receiver pressure, the power component of the receiver is $I \cos \theta$ and the wattless component is $I \sin O$ (for non-inductive load $\theta = O$). Let oa (Fig. 2) be the pressure E considered constant and equal to 100%. The pressure consumed by the resistance

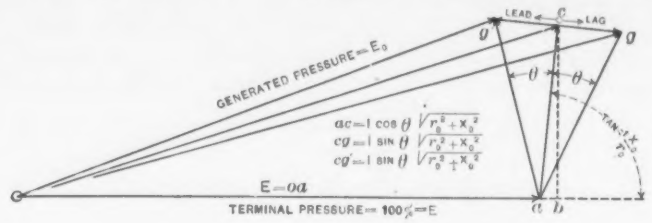


FIG. 2.—GENERATOR DIAGRAM.

and reactance due to the power component of the load current is $I \cos \theta z_0$. In Fig. 2, $a\,b = I \cos \theta\ r_0$,

$$b\,c = I \cos \theta\ x_0.$$

Therefore $a\,c = I \cos \theta \sqrt{r_0^2 + x_0^2} = I \cos \theta\ z_0$, z_0 being the impedance. $a\,c$ represents then in magnitude and direction the pressure consumed over the impedance z_0, by the power component of the receiver current. $a\,c$ is proportional to the output since E is constant. If for a lagging current we make the angle $cag = \theta$ (θ is the angle by which the receiver current lags behind the receiver pressure), and the angle $acg = 90°$, then

$$cg = I \sin \theta \sqrt{r_0^2 + x_0^2} = I \sin \theta\ z_0,$$

as can be proved by simple geometry. That is, cg represents in magnitude and direction the pressure consumed over the impedance by the wattless component of the current. If the current leads the receiver pressure by the angle θ, then cg^1 is equal to the pressure consumed by the wattless component of the current. The line ag, therefore, represents in magnitude and direction the pressure consumed by the total current delivered by the genrator. ab and bc are laid off in percentage of E. oc is the pressure generated for a non-inductive load. For the same load and a power factor corresponding to the angle θ and lagging receiver current, og is the pressure which must be generated. For the same load, but leading current, og^1 is the pressure generated. ac may represent the percentage pressure consumed by full load non-inductive current. Then $ac/2$ will represent half load, etc. Fig 3 shows the same diagram with lines drawn at right angles to ac at one-quarter, one-half, three-quarters, and full load. Radial lines making angles with ac corresponding to $\cos \theta = 1$, $\cos \theta = .98$, have been drawn. With o as center and radii equal to 95%, 100%, 105%, etc., circular arcs have been drawn. From this

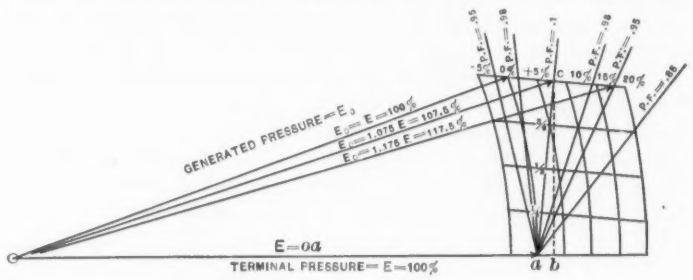


FIG. 3.—GENERATOR DIAGRAM.

figure we see that the generated pressure for non-inductive full-load must be 7½% higher than the terminal pressure. For a power factor equal to .95, lagging current, the generated pressure must be 17½% higher than the delivered pressure. At a power factor of .85 and three-quarter load, the generated pressure must be 20% higher than the delivered pressure. For a power factor of about .97, leading current $E_0 = E$.

With 100% receiver pressure laid off to a scale of about ten inches, it is possible to get results accurate within 1%. As this is as close as measurements could be made on any generator with the best obtainable commercial instruments, this graphical method is perfectly satisfactory.

Let us now see what change takes place if we operate this generator as a motor. Leaving the pressure E_0 as before, we must reverse E, and the direction of the current, so that power is now

*A Simple Diagram Showing the Regulation of a Transmission System for any Load and any Power Factor. By F. G. Baum. *Elec. World and Eng.*, May 18, 1901.

absorbed by the motor. The terminal pressure E is again assumed constant and laid off horizontally, but to the left of a. Fig. 4 shows the method of constructing the synchronous motor diagram when the current is in phase with E.

$$ab = Ir_0,$$

$$bc = Ix_0.$$

Therefore $ac = Iz_0 = I\sqrt{r_0^2 + x_0^2}$.

ac, so long as the current is in phase with E, is proportional to the power output, since ac is proportional to the current (the mechanical output will be equal to the electrical input minus the losses. The

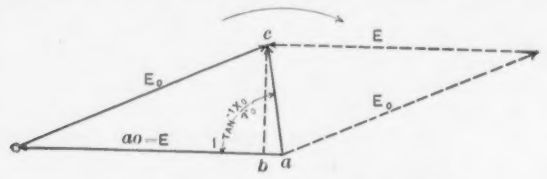


FIG. 4.—SYNCHRONOUS MOTOR DIAGRAM.

friction and iron losses are constant, and the variable loss is equal to I^2r_0). The excitation for an input corresponding to ac is $oc = E_0$.

Suppose now the current to lag behind the impressed pressure by the angle θ, Fig. 5. The pressure consumed by the power component of the current for the same input is still $ac = I \cos Oz_0$. If the current lags, the pressure consumed by the wattless component of the current, $I \sin O$, is $cg^1 = I \sin Oz_0$. The pressure consumed by the impedance z_0 by the total current is $ag^1 = Iz_0$. The value of E_0, the excitation of the motor, which will give a power factor equal to $\cos \theta$, lagging current, for an input corresponding to ac, will be og^1. If E_0 is made equal to oc, then for the same input the current becomes in phase with the pressure E. (A given input means prac-

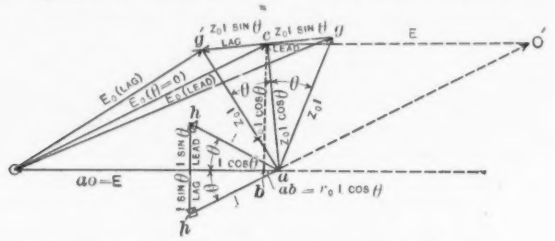


FIG. 5.—SYNCHRONOUS MOTOR DIAGRAM.

tically a given output, since the variable loss due to the change of I is small.) If the excitation for the same input is raised to the value og the current will lead the pressure by the angle θ. The point i is found as follows: Suppose, for example, we consider a motor for one thousand volts and 100 amperes, the resistance of the motor being .2 ohm, and the reactance 4 ohms (in a polyphase motor these would be the quantities per phase). E is laid off horizontally equal to 10 inches, say, = 1,000 volts. $ab = .2 \times 100 = 20$ volts = .2 inch. $be = 400$ volts = 4 inches. ac may then be drawn. ac will always represent an input of 1,000 times 100 = 100 kw. For 150 kw ac would be increased in proportion. In Fig. 6, lines have been drawn at

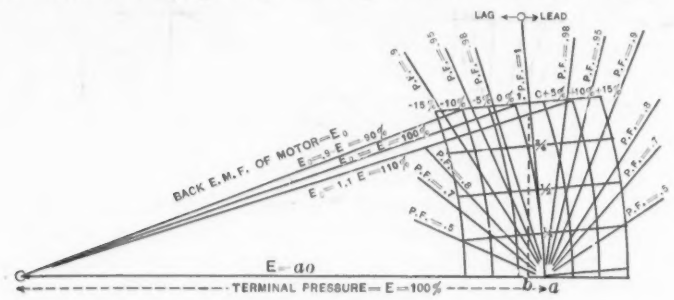


FIG. 6.—SYNCHRONOUS MOTOR DIAGRAM.

right angles to ac at points marked ¼, ½, ¾ and full-load. Circular arcs, with o as center and radii, equal to 95%, 100%, etc., have been drawn. Radial lines making angles corresponding to different power factors have been drawn from a. The power factor and wattless current for any particular load and excitation, or the excitation for any load and any power factor may be determined at once from the figure. The use of the diagram will be shown later.

For motors of different sizes and of different make the ratio of ab to bc, the pressures consumed by resistance and reactance will be different. The angle between ab and ac will generally be between 85° and 90°. If the resistance and reactance of a line is added the angle between ab and ac may be smaller than 85°. For the same ratio between ab and bc, ac will be a different percentage of the terminal pressure E in different motors. ac will generally vary between 25% and 50% of E. In Fig. 7 has been drawn a case corresponding to an angle of 84½° between ab and ac (the limiting value of this angle is 90°, shown by the dotted line.) Points along ac have been marked 10%, 20%, etc. These represent the percentage pressure consumed by the load component of the current; *e. g.*, at full load a given motor may consume 40% of pressure by its impedance when the current is in phase with the pressure at its terminals. Then the point 40% would represent full load on the motor, 20% one-half load, 60% one and a half load, etc. It will be seen that all lines in this figure remain the same except the power factor lines which rotate about a, so that ac makes the angle $= tan^1 \frac{x_0}{r_0}$ between ao and ac. From this diagram may be obtained:

(1) The excitation to give any particular power factor at any load.

(2) The excitation to give any required wattless current at any load.

(3) The power factor and wattless current for any load and excitation.

(4) The angular swing of motor for any load and excitation.

(5) The maximum input or output for any particular excitation.

(6) The V-curves between current and excitation.

These will be illustrated by examples, the numbers referring to the numbers above. We will assume a motor in which the impedance consumes 40% pressure on full-load current.

(1) Find the excitation which will give a power factor of unity at full load: go along ac to the point marked 40% (assuming that 40% pressure is consumed by the impedance by full-load current), and we see that the motor must be over excited 4%. If $tan^1 \frac{x_0}{r_0}$ were practically 90° the motor would have to be over-excited about 8%, as may be seen by going along g^1g to the broken line which makes an angle of 90° with ao. To give a power factor of .8 leading current, go to the point g: excitation 1.35 E. To give .8 power factor, lagging current, go to the point g^1; excitation .75 E.

(2) What excitation will make the wattless lagging current equal to one-half the load current when the motor is carrying half-load? Go along the line at right angles to ac, at the point 20%, a distance equal to one-half the distance from a to 20%: excitation equals .9E.

(3) Suppose the excitation to be .9 E at one-quarter load, what will be the power factor and wattless current? The intersection of $E_0 = .9$, with the line at right angles to ac at 10%, gives a power factor of about .7, and a wattless current equal to the load current.

(4) For any particular position of E_0, the electrical angle through which the motor must swing from no load to the new load is equal to the angle between E_0 and E (this assumes that instead of the true self-induction and the magnetizing or demagnetizing effect of the armature, we may use the synchronous reactance). The mechanical angle will be equal to the electrical angle divided by the number of poles.

(5) What is the maximum input when $E_0 = E$? Follow the circular are $E_0 = E$ until we get maximum projection on ac; the projection on ac gives the load. The length along ac is seen to be 110%; therefore the input is 110/40 = 2.75 times full load. The power factor as shown would be about .75. The current in the motor is ag_2, and may be scaled off.

(6) To determine the V-curves, assume different excitations for the same load. For full-load: if $E_0 = 1.04\ E$, the current is a minimum, and equal to the length from a to the point along ac marked 40%. If $E = .75\ E$, the armature current is ag^1. If $E_0 = 1.35\ E$, the armature current is ag. For any other load move along the line at right angles to ac at the point corresponding to the load.

COMPOUNDING OF SYNCHRONOUS MOTORS.

Suppose this motor to be working at the end of a transmission line, and it is desired to vary the excitation so that changes in load on the motor will not cause a drop in pressure at the motor terminals with constant pressure applied to the transmission line at the generating end. The synchronous motor may be driving a direct-current generator, in which case the load on the motor would be proportional

to the output of the generator. The motor excitation may be raised from no load to full load by carrying a series winding around the field of the motor, the current in the series winding being taken from the load on the direct-current generator.

For this problem we must first draw a figure, Fig. 8, showing the regulation of the transmission line for any load and any power factor of the motor. In Fig. 8, the pressure E equals 100%, is the pressure to be maintained at the motor terminals (the point o is not shown in the figure). ab is the resistance pressure (equal 8% of E), and bc is the reactance pressure (equal 21% of E) consumed over the line by *full load motor current* when the current is in phase with the pressure at the motor terminals. That is, abc is the triangle of e. m. f. consumed over the line by non-inductive current. The drop in pressure at full load non-inductive current is seen to be 10%. The regulation for any load and any power factor may be determined from the figure. If we draw a wattless lagging current over the line the pressure consumed by it will be at right angles to ac in the direction cg. If we draw a leading current over the line the pressure consumed by the leading component will be at right angles to ac in the direction of cg^1. It is desired, now, to vary the excitation on the motor so that the pressure will be constant for any load on the motor, with constant pressure at the generator. Suppose we say that at ¾-load on the motor the current shall be in phase with the pressure at the motor terminals. For this load there is no wattless current drawn over the line, and the value of E_0 is given by the point .75 along ac. Draw a circular arc through this point with O as center, shown by the heavy line. At any other load the pressure at right angles to ac, consumed by the wattless current, must reach this circular arc. We see that the generator pressure is to be 7% higher than the receiver pressure at all loads, since the 7% arc passes through the point marked .75. Let us first determine the excitation of the motor when the D. C. generator to which it is connected is carrying no load. If the losses in motor and generator are 10%, this would mean 10% energy current drawn over the line by the motor. Going along ac, Fig. 8, to the point 1, and then at right angles to ac to the 7% arc, we see that the power factor at this load must be .36. Going to Fig. 7, to determine what excitation will give us this power factor at the motor terminals at .1 load, we see that the value of E_0 must be equal to .85 E; that is, the motor must be under-excited 15% at no load. At ¾-load we must set the excitation of the motor so that no wattless current is drawn over the line. Going again to Fig. 7, to the point 30% along ac (corresponding to ¾-load on the motor), we see that the excitation E_0 must be 2% higher than E. We would, therefore, set

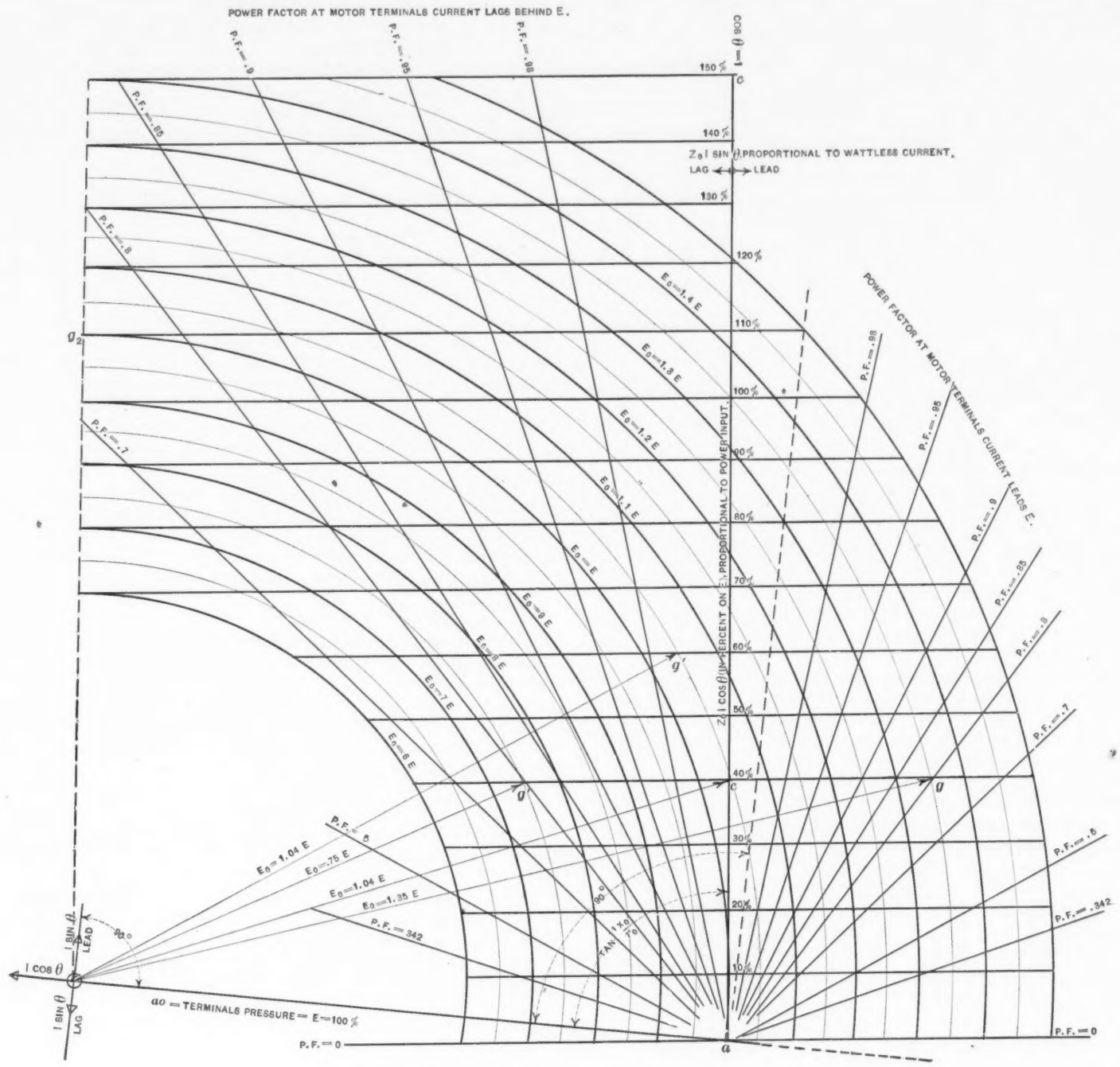


FIG. 7.—SYNCHRONOUS MOTOR CALCULATING DIAGRAM.

the shunt excitation of the synchronous motor equal to .85 *E* at no load. Then with ¾-load on the motor adjust the current in the series coil until the motor draws non-inductive current. The excitation on the motor then will increase with the load, the motor drawing lagging current at no load, non-inductive current at ¾-load,

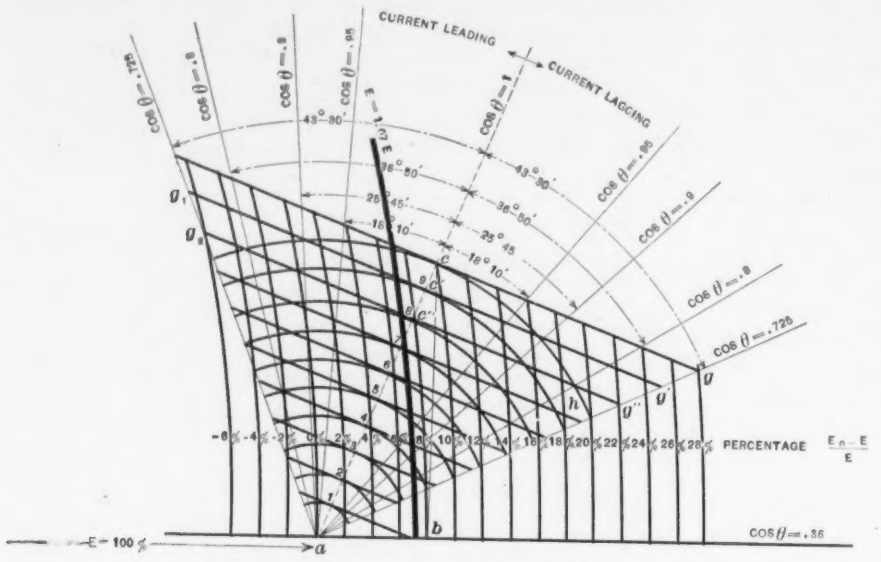


FIG. 8.—REGULATION OF TRANSMISSION LINE.

and leading current with power factor of about .99 at full load. At full load the excitation will be about 1.09 *E*. From no load to full load the excitation changes from $E_0 = .85\ E$ to $E_0 = 1.09\ E$, or is raised 24%.

Exhibits at the Annual Exhibition of the French Society of Physics.

At the annual exhibition of the French Society of Physics, held in Paris on April 5 and 6, a large number of interesting exhibits were shown. As the rooms were only opened to the public a few hours on each of the days, there was considerable complaint on the part of visitors, since the time admitted of only a rapid examination of the numerous exhibits.

M. and Madame Curie gave an exhibition of radium rays. Solutions of sulphate of zinc and radium chloride were placed in separate bulbs connected by a tube, and it was shown that the former becomes phosphorescent from the influence of the latter. The light emitted by the latter is, however, about 1,000 times more powerful than the light emitted from the radium. The diameter of the connecting tube may be made extremely small—in fact, it may be a capillary tube—but cutting the connection between the two bulbs stops the influence of the radium.

Prof. Blondel showed no less than six interesting pieces of apparatus. One of these was a high-speed revolving mirror for the study of Hertzian waves. The mirror is secured to the shaft of a small steel Pelton wheel of extremely sma diameter, which is revolved by a stream of gas from a cylinder of carbonic acid. With this device a speed of 1,000 r. p. m. was obtained. A "Foucault current" telephone was shown for use in wireless telegraphy. The principle is an application of the phenomenon of repulsion of induced alternating current, discovered by Prof. Elihu Thomson. The telephone consists of a coil through which pass currents of high frequency taken, for example, from a receiving antenna; there is an aluminum diaphragm in which the coil induces Foucault currents. Whenever oscillatory current passes through the coil, there is a repulsion and the telephone indicates all the interruptions and variations of the oscillations.

A Blondel bifilar oscillograph was shown having a permanent magnet, and presenting a great improvement over other types of bifilar oscillographs with respect to facility of construction and sensitiveness. The mechanism is simple of adjustment, and its sensitiveness reaches 10,000 to 12,000 periods and 200 to 250 mm. per ampere at one meter with a permanent magnet; and three times these figures with an electromagnet. The synchronoscope and the mounting are the same as in the case of the soft iron oscillograph.

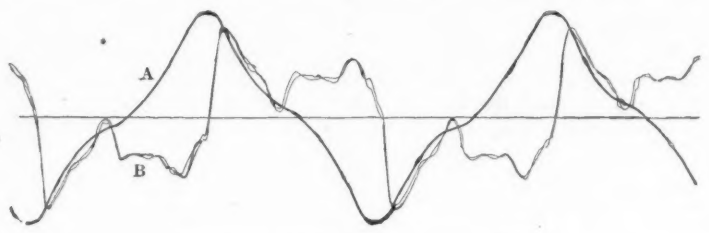
A Blondel chronograph was shown, consisting of a simple soft iron oscillograph with electromagnets, having a periodicity exceeding 50,000 p. p. s. In operation the current to be studied is passed through the coil and each rupture produces a series of oscillations, which may be recorded alongside a curve of the phenomenon under investigation. By this means a measure of time is obtained much more sensitive and of greater limits than with electro-diapasons.

Prof. Blondel also showed a cinemato recording oscillograph, which will register on a photographic band 100 successive oscillations, or even more, such as a variable alternating current in function of time. The band is wound on a roller operated by a constant speed electric motor of a type which gives a result much superior than is attained with the usual cinematograph arrangement.

A Blondel fluxograph was shown, which consists of a galvanometer without directing force or damping, and which records the curves of variation of magnetic flux in circuit. A trial bobbin is placed around an iron core subject to a variable flux; the induced e. m. f. is at each instant proportional to the variation of flux, and the coil is connected to a small transformer without iron, of which the secondary is connected to the galvanometer. In the latter, granting that the time constants of the circuit are rendered negligible, a current passes proportional to the second derivative of flux. The galvanometer having neither a directing couple nor damper, its deviations register a cycle rigorously proportional. These deviations proportional to the time are reflected by a revolving mirror having a constant velocity, as in the case of an oscillograph, and the curve of the flux is thus obtained in function of time. The galvanometer consists of a small coil enclosed in an iron box, which shields it from all exterior fields; the coil acts on a small magnetized bar pivoted between jewels and enclosed in an exhausted glass tube. If instead of a mirror of constant velocity, there is employed to reflect the rays a plane mirror fixed to a galvanometer, having its axis horizontal to the oscillations, and through which the magnetizing current passes, it is possible with the aid of a fluxograph to trace directly the magnetizing periods of a specimen of iron by the Hopkinson or tore methods.

The Abraham rheograph, a form of the Blondel oscillograph, was shown connected with a street lighting circuit supplied by a Ferranti generator. By means of a variable inductance in the circuit, the different harmonics in the circuit up to the eleventh were shown. The third and fifth harmonics were particularly perceptible.

Prof. Hospitalier exhibited his "ondograph," which is based on the Joubert or point-by-point method of plotting periodic curves. While this instrument is not fitted for registering variations of a non-periodic character, it is of simple construction and easy of manipulation. A succession of periods is used in connection with condensers, the charges of which pass through a Weston voltmeter, the reading of which gives points of the curve. Displacing the



SPECIMEN RECORD FROM ONDOGRAPH.

charging contact of the condenser by determined angles and reading the voltmeter for each position of the contact, gives corresponding points of the waves, which consequently may be plotted point by point. The charging and discharging commutator is run by a synchronous motor operated from the system furnishing the wave to be plotted. The accompanying curves are specimens of the records taken by the apparatus. Curve *A* is the wave form of the Rive Gauche alternating system, and curve *B* is the wave of secondary current.

Prof. Hospitalier also showed a manograph to represent the pressures in a gasoline motor. The diagram is represented on a screen of ground glass by means of a moving mirror. The piston displace-

ment deflects the mirror in one direction, and the variation of pressure in the cylinder deflects it in another direction. The resultant motion produces the curve, and the persistency of luminous impression on the eye gives the effect of a complete curve. Photographic reproductions of the card may be obtained from the ground glass representation.

An acetylene process of soldering metals was shown. High temperatures are obtained by an oxyacetylene blow-pipe similar to the well-known oxyhydrogen blow-pipe; it is claimed, however, that the former is more efficient and cheaper and gives a temperature as high as 3200° C.

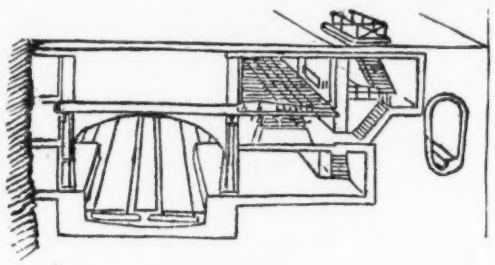
M. Nodon showed an aluminum-carbon electrolytic rectifier, a full description of which will appear later. A number of arc lamps were shown; among others, the Froment lamp, which is the first enclosed arc lamp of French origin. A large number of radiographic appliances were exhibited, and it is to be noted that in this line of work there is a tendency toward the use of static machines as preferable to other sources, experience having shown that better results may be obtained from their use.

Rolling Platform for Paris.

A plan has recently been proposed by a well-known French engineer, M. Casalonga, for providing Paris with a rolling platform, running from the Place de la Concorde to Place de la Bastille under the Grand Boulevard, a total length of 6 miles.

The present service of the existing omnibus line, called the Madeline-Bastille, is known to be far from satisfactory, with respect both to capacity and schedule. Moreover, this line passes through crowded districts where the traffic will be congested and slow in spite of all improvements. The traffic of this line is very heavy, corresponding to 15,000,0000 passengers a year, and could reach 30,000,000 were it possible to supply vehicles and seats.

A rolling platform, it is believed, would have a very great advantage, and the traffic would thereby be further increased owing to the



CROSS-SECTION OF TUNNEL.

superior facilities and the less fare proposed by the promoters of the scheme. Stairs would be installed every 650 feet, one set for going in and another for going out of the shallow tunnel of the running platform. The maximum distance to walk to a station would, therefore, be 325 feet. The uniform fare proposed is 2 cents.

The platform itself would consist of three parallel parts running with speeds of 2.4, 5 and 7 miles per hour, respectively. A passenger walking on the third platform could thus attain a speed of 9 to 10 miles. The promoters are contemplating even a quadruple platform, making the higher speed as great as 12 to 14 miles per hour.

A cross-section of the tunnel proposed is shown in the accompanying cut, running parallel to a proposed line of the Paris Metropolitan. The expense is estimated at $1,700,000 per mile of double track, and the running expenses, calculated from the experience gained with the rolling platform of the Paris Exposition, which transported more than 70,000,000 passengers in 1900, would amount to $400,000 per year.

Wireless Telegraphy in the Navy.

The information comes from Berlin that the U. S. Navy Department has decided to adopt the Braun-Siemens-Halske system of wireless telegraphy, and that a large consignment of apparatus will be sent to Washington in June.

Farewell Dinner to Lord and Lady Kelvin.

On Thursday, May 8, a farewell dinner was given by Mr. Anthony N. Brady, president of the New York Edison Company, in honor of Lord and Lady Kelvin, who sailed May 10, after a stay in this country of barely three weeks. This interesting and delightful function took place in the roof garden at Delmonico's, on Fifth Avenue. During the afternoon Lord Kelvin, escorted by the officers of the company, visited the fine new Waterside Station of the Edison Company, on the East River, recently described in these pages, and spent considerable time in making a thorough inspection of the equipment and the various engineering features. In spite of the fatigue imposed by this and other sight-seeing during the day, Lord Kelvin was in the best of health and spirits when he arrived at Delmonico's with Lady Kelvin, and, together with Mr. and Mrs. Brady, held an informal reception before the dinner. The following were present:

Lord and Lady Kelvin, Graham J. Blandy and Mrs. Blandy, John Bottomley and Mrs. Bottomley, A. N. Brady, president New York Edison Company, and Mrs. Brady; N. F. Brady, vice-president and treasurer New York Edison Company, and Mrs. Palmer Gavitt; J. C. Brackenridge, general manager Brooklyn Rapid Transit Company, and Mrs. Brackenridge; E. P. Bryan, general manager Rapid Transit Subway Company; J. J. Carty, chief engineer New York Telephone Company, and Mrs. Carty; Prof. F. B. Crocker, Columbia University; C. L. Edgar, president Boston Edison Company, and Mrs. Edgar; Thomas A. Edison and Mrs. Edison; Walton Ferguson, director Brooklyn Edison Company; Anson R. Flower, director Brooklyn Rapid Transit Company, and Mrs. Flower; Harrington E. Gawtry, president Consolidated Gas Company; Lewis B. Gawtry, secretary New York Edison Company, and Mrs. Gawtry; J. L. Greatsinger, president Brooklyn Rapid Transit Company; E. A. Leslie, general manager Brooklyn Edison Company, and Mrs. Leslie; John W. Lieb, Jr., associate general manager New York Edison Company, and Mrs. Lieb; W. M. McFarland, vice-president Westinghouse Electric Manufacturing Company; E. A. Maher, president Union Railway Company, and Mrs. Maher; W. S. Mallory, secretary to Thomas A. Edison, and Mrs. Mallory; T. Commerford Martin, editor ELECTRICAL WORLD AND ENGINEER, and Mrs. Martin; John B. McDonald, contractor Rapid Transit Subway, and Mrs. McDonald; Rear-Admiral Geo. W. Melville, U. S. N.; D. O. Mills, president Niagara Falls Power Company; Thomas E. Murray, general manager New York Edison Company, and Mrs. Murray; Stephen S. Palmer, director New York Edison Company; Henry Sanderson, president New York Transportation Company, and Mrs. Sanderson; Frank J. Sprague and Mrs. Sprague, M. G. Starrett, chief engineer Metropolitan Traction Company, and Mrs. Starrett; Lewis B. Stillwell, consulting electrical engineer Rapid Transit Subway Company and Manhattan Railway Company, and Mrs. Stillwell; H. G. Stott, superintendent motive power Manhattan Railway Company, and Mrs. Stott; Nikola Tesla, Charles Trippe, Anglo-American Cable Company, and Mrs. Trippe; J. Van Vleck, mechanical engineer Rapid Transit Subway Company; and Geo. G. Ward, vice-president Commercial Cable Company, and Mrs. Ward.

There were but two toasts after the dinner, it being desired by Mr. Brady that the affair should be a social rather than a formal function. In proposing the health of Lord and Lady Kelvin, the toastmaster said that the occasion might be likened to a gathering of the captains of electrical industry, in view of the representative character of the men assembled from all branches of the science and art, but, considering the shape of the board around which they sat, they might also be styled "Knights of the Round Table." They were indeed warranted in accepting this designation, for never were quests more daring and venturesome than those upon which the founders of the utilizations of electricity had embarked. Indeed, it would not be unseemly to compare with the mystical cup of the Holy Grail, which evaded the grasp of those who sought it, the pure and beautiful incandescent light which the genius of Edison and others had actually put into the hands of the world, or even those wonderful tubes of Tesla, in which the rarefied air beating the crystal walls of its prison burst into such an effulgence as "never was on land or sea." The French poet Maeterlinck had said that scientists and inventors were but camp followers of great forces which they could not see. This was not true, for such men as were around that table

that night were not followers, but leaders; men who had risked much to confer upon the world the inestimable benefits of electricity.

In proposing the health of Lord and Lady Kelvin, it was hoped that this would be by no means the last time that an opportunity would be afforded to greet them in this country, but they must not forget that it was full 60 years since Lord Kelvin had established his famous parallel between the phenomena of heat and those of electricity and had laid the basis of his own imperishable association with electrical development. His first trip to this continent had been connected with the memorable work, which, as John Bright said, had "anchored the old world alongside the new." That there should be no more sea was a promise of prophetic Scripture. That there should be no more sea was the resolve, 40 years ago, of undaunted Cyrus Field and modest William Thomson, so far as the intercommunication of intelligence as concerned, and the results which had crowned their work were known to all men. Since then, Lord Kelvin had added to his gifts to the world and to mariners, his perfection of the compass and his deep sea sounding apparatus. They might now in fairness ask him to abolish the physical drawbacks due to the existence of the ocean, and if Britannia could not rule the waves straight, they might at least ask Lord Kelvin to reduce the Atlantic to one wave length.

Since the guests of the evening had landed on the present trip, Lord Kelvin had gone through four American universities in sixteen days. This gave but a fair indication of the unusual calibre of the man. It took most Americans at least four years to go through one university, and even then if they got any kind of degree with credit they were lucky. Lord Kelvin had wound up his rapid transit university courses by receiving an LL. D. degree from Yale, which for the first time in 100 years had assembled a special convocation for such a purpose. It was safe to say that at least 100 years would pass before Yale would have another opportunity to confer such a degree again so worthily and properly.

And now having escaped from the tender mercies of the professors, Lord Kelvin was among those who could claim the closest bonds of fellowship with him as brethren identified with all the great electrical developments of the age, represented at the banquet that night. When Lord Kelvin began his career, not a cent was being spent on electrical applications in this country. Not long since their host of the evening, Mr. Anthony N. Brady, had published a most interesting article in the *North American Review*, on the development of electrical applications, and taking those figures as a basis, it would appear that every American man, woman and child was now spending upon the average seven dollars a year for electricity. In fact, it might almost be claimed that Americans were spending as much for electricity as for daily bread, a fact which contributed, doubtless, in no small degree to the rapid advance which this country had made; a fact, moreover, which was largely due to the science, the inventive ability and the many beautiful pieces of apparatus which they owed to Lord Kelvin. The toastmaster, therefore, in proposing the health of Lord and Lady Kelvin, asked them to drink with three times three to their distinguished comrade-in-arms, the greatest physicist of the age and the leading electrician of his time.

Lord Kelvin was enthusiastically received, and in acknowledging the honor done to himself and Lady Kelvin, disclaimed very modestly his right to have so large a part of the electrical advance put to his credit, but avowed his deep and unceasing interest to-day, as ever, in the work which was being accomplished to put electricity at the service of mankind. He spoke of the intense pleasure which he had had in visiting that day the splendid Waterside Station, constructed by the New York Edison Company, of which Mr. Brady was the head, and he said that among the things which gave him pleasure there was not only to ascertain the fact that the Edison circuits were now distributed from one end of the city to the other, but that the big generators in the station illustrated the polyphase ideas which Mr. Nikola Tesla had done so much to forward. It had also delighted him to see the splendid development of the electric railway work in New York and throughout the country, due to the work of such men as Mr. Frank J. Sprague. So far as New York was concerned, it must be regarded as the best lighted city in the world, thanks to electricity—he had almost said in the universe—but he was not quite sure what they were doing in Mars. If, however, the Martians had their eyes fixed on this world, they certainly would be contemplating Manhattan Island, as the brightest point to fix their attention. Lord Kelvin then referred to the interesting developments which he had seen in photography at Rochester, as the guest of Mr. Eastman, and the interesting utilization of Westinghouse apparatus at Niagara Falls. He said that the Great Cataract would not only remain a beautiful spectacle, but that, thanks to electricity, it would be able to give up practically its entire energy for the benefit of the welfare of mankind, and he did not know any higher use to which it could be put. They were now developing at least 40,000 horse-power there, and he would himself like to be able to see the time when Niagara was giving up at least 4,000,000 horse-power of her energy, distributed over an area of hundreds of square miles.

Lord Kelvin referred emphatically to the great debt which the world owed Mr. Edison, whose light, he said, was now in use throughout the civilized world, not only in America but all over Europe and Asia, and even among the Zulus in South Africa. In conclusion, Lord Kelvin, for himself and Lady Kelvin, thanked the electrical men of America from the bottom of his heart for their sympathy and friendliness, and said that they would carry away with them the most pleasant and agreeable recollections of this visit to the United States.

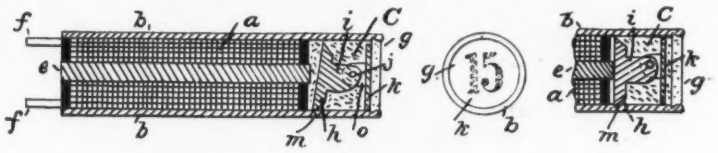
Lord Kelvin's remarks were received with the most unbounded applause and with three cheers. Rear-Admiral Melville then proposed the health of Mr. Anthony Brady, in acknowledgment of the felicitous opportunity he had given them all to pay their honor and respects to the guests of the evening; and the party then broke up. It should be noted that a very handsome menu was provided, designed by the drafting department of the New York Edison Company, and possessing unusual artistic merit. It was a large quarto, in dark slate outer cover, bearing in gold the Kelvin coat of arms. Inside were four pages, on heavy white paper, in tint. A portrait of Lord Kelvin occupied the central space, and in medallions around it were pictures of the Great Eastern and of the various instruments invented by Lord Kelvin and connected with his work and fame.

New Telephone Patents.

The issue of May 6 contains three patents directly relating to the art of telephony, and on or two others having more or less bearing on matters telephonic, such as cable-hangers, iron poles and a detail improvement on that ingenious apparatus, the telegraphone.

Mr. Charles Chandler Blake, of Brookline, Mass., is the patentee of an annunciator of a novel type, in which the target works in a small chamber in front of the magnet, hermetically sealed by a glass window. The chamber contains, besides the armature and target, a quantity of dark-colored liquid, which serves to conceal the target when it is not pressed against the window of the chamber. In the drawings a preferred form of annunciator is shown, though various ways of carrying out the idea may be devised, and Mr. Blake claims broadly the method of restoring an annunciator by placing the target in a glass-fronted chamber containing an opaque liquid which conceals the target in one position and allows it to be seen when in another.

Referring to the drawings, Figs. 1 and 3 are sectional views, and Fig. 2 an end view of the preferred form of annunciator; *a* the



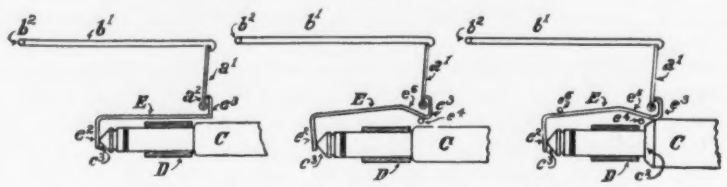
FIGS. 1, 2 AND 3.—BLAKE ANNUNCIATOR.

electromagnet is enclosed in an iron sheath *b*, which projects beyond the end of *a* and is provided with an internal groove in which is secured a glass disk *g*, which closes the chamber *C* and serves as a window. Within the chamber *C* is a tilting armature *h*, in the form of a truncated cone, and having an arm *i* extending from its end pivotted at *j* to the arm *o*, projecting from the rear of the disk-target *k*. In the unattracted position of the armature, as indicated in Fig. 1, the target presses against the inner surface of the window *g*. The face of the target is of a distinctive color, and may carry the number, or the number may be on the window *g*, if preferred. The chamber *C* is fitted with water, having in solution some coloring matter, which will render it opaque. Nigrosine, a blue-black, coal-tar dye is suggested.

In the form of indicator shown, the target is exhibited when the magnet is inert, and is withdrawn, and concealed by the opaque-

liquid, when the magnet is energized and *e* is attracted. By putting the armature at the other end of the core and subjecting it to the tension of a spring, the target will be shown when the armature is attracted, and concealed when it is unattracted, the armature and target being joined by a connecting-rod passing through the center of the core.

Mr. Henry M. Fisk, of Wheaton, Ill., is the inventor of a combined drop and jack, embodying a mechanical self-restoring movement of a type that has become moderately familiar since the idea of a self-restoring drop first became spread abroad. As shown in the drawings, Mr. Fisk's method of causing the answering-jack to effect the restoration of the drop-shutter has no feature of very startling novelty. In the drawings, Figs. 4, 5 and 6 show clearly the means



FIGS. 4, 5 AND 6.—FISK COMBINATION DROP AND JACK.

used in conveying the motion of the plug to the shutter, and Fig. 7 shows the complete drop and jack. The connection consists of a slide, *E*, which is pushed in along the jack by the tip of the plug, and whose outer end, e^3, bent upward, engages with the drop-shutter and pushes it home. To make the action of *E* a little more positive, it is provided with a curled-in end at e^3, and with a bend e^5, and bearing e^4 and e^6 to steady it, the shoulder of the plug-handle also serving as a bearing for the lower side of the bent end e^3, as shown in Fig. 6. In the complete organism of combined drop and jack, the slide *E* is provided at the inner end with an insulating stop e^7, to prevent metallic contact between the plug and the slide. No means of retracting the slide from its inner position after the withdrawal of the plug is shown; presumably the falling of the drop-shutter is depended upon for this, but it seems probable that in actual working the drop would at times remain locked by the slide.

A telephone-circuit system, devised by Mr. Ellis F. Frost, of Washington, D. C., has for its object the provision of a common return wire for an exchange telephone system, the common return also serving as a battery supply line. This is effected, and therein lies the principal novelty of the invention, by connecting the common return to earth through condensers of large capacity, thus making the common return wire into an artificial earth, having all the con-

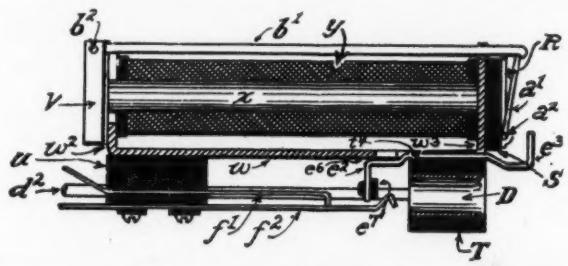


FIG. 7.—FISK COMBINATION DROP AND JACK.

veniences of a direct connection to earth with none of its disadvantages, such as the introduction of cross-talk and of sneak currents. A highly ingenious idea, but of doubtful practical application, since to imitate the earth by means of condensers would imply the use of megofarads instead of the humble microfarads of commerce.

Mr. Ellis's theory is that "the earth, except for very short distances, and under favorable conditions, does not serve as a return for a circuit connected to the earth at both ends. In other words, no flow of electricity takes place through the earth between the ends of the line. The earth only serves as a vast reservoir of an infinite capacity, whose state at one place is kept in equilibrium with that of another, however disturbed, not by a current flow through the earth, but by an adjustment of the capacities between the places through inductive relation." Mr. Frost is his own patent attorney, and his specification suffers accordingly, as this extract shows. That "only" in connection with the earth as a vast reservoir is naïve; while the explanation of the "adjustment of the capacities" of the globe we inhabit is hardly convincing.

Referring to Fig. 8, it will be seen that Mr. Frost's invention is exceedingly simple. *A*, *B* and *C* represent three of any number of telephone exchanges, 1 and 2 at each exchange represent subscribers' lines; at exchange *C*, 13 and 14 are subscribers' lines, enjoying a local connection through cord circuit 15, the other lines are connected, 1 in *A* to 1 in *B* by trunk line 10, 2 in *A* to 2 in *C* by trunk line 11, and 2 in *B* to 1 in *C* by trunk line 12. From each exchange a line, 3, of comparatively low resistance extends to each subscriber of that exchange. This line serves as a common return for all the lines of its exchange. All of these common return lines, 3, are connected together by the common return trunk-line 4. At each exchange there is a battery, 5, one pole connected to earth, the other to common return line 3, thus making 3 a battery supply line for all the subscribers' stations to which it extends. The common return and common return trunks should be of a resistance comparatively low in relation to that of the telephone lines, so as to reduce all tendency to cross-talk to a negligible quantity.

When a telephone line is connected for talking purposes the battery

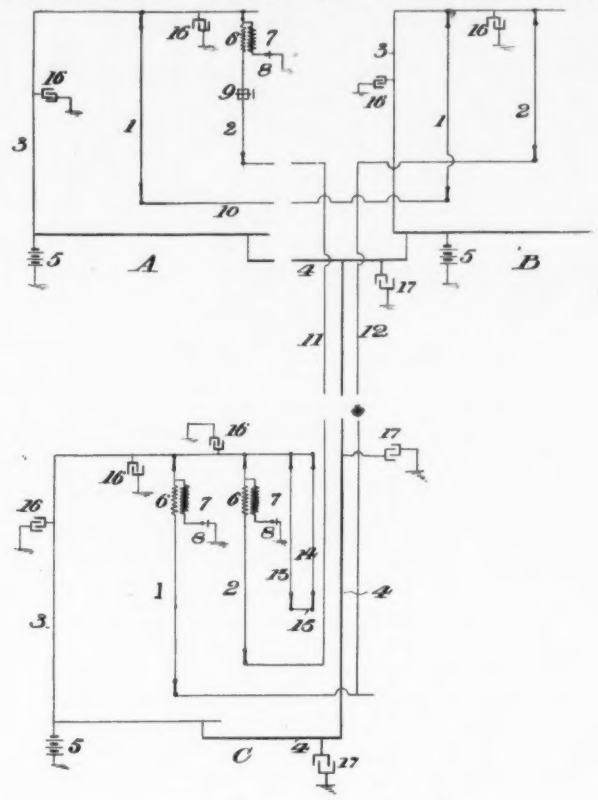


FIG. 8.—FROST TELEPHONE CIRCUIT SYSTEM.

supply line is connected to earth through the primary, 7, of the induction coil and the transmitter, 8. This completes an earth return circuit for the battery over the line 3. To overcome the cross-talk that would result when two or more lines are so connected, the line 3 is connected to earth through condensers, so as to give it a high static capacity. A sufficient number of condensers, 16, is used, and they are so distributed along the line as to insure a great static capacity to the line. The common return trunk line, 4, is similarly equipped with condensers, 17. The high static capacity given to the lines 3 and 4 by the condensers is calculated to prevent cross-talk and to "iron out" disturbing currents from other sources. Mr. Frost does not specify of what capacity he would make his condensers.

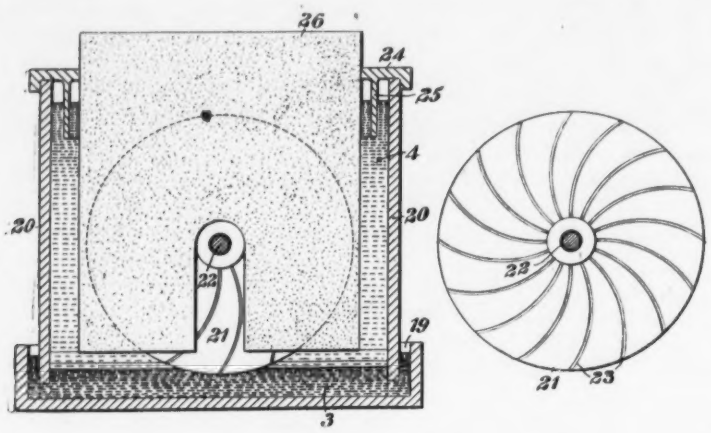
Meeting of the Engine Builders' Association.

The following is the programme for the meeting of the Engine Builders Association of the United States, at Pittsburg, next week, beginning Thursday, May 22, 1902. Welcoming address—President W. M. Taylor. Paper—"Engine Forgings," H. F. J. Porter, New York; discussion. Paper—"Engine Requirements for the Parallel Operation of Alternators," E. M. Tingley, Pittsburg; discussion. Paper—"Piping Materials for Steam Plants," John B. Berryman, Chicago; discussion. Paper—"The Requirements for the Paralleling of Alternators as Viewed by the Engine Builders," H. M. Longwell, Pittsburg; discussion. On Friday, there is, among other things, a visit to the Westinghouse Engine Works, and a dinner at the Schenley in the evening.

Mercury Cathode Cells—Electric Combustion Furnace—Artificial Camphor.

By CLINTON PAUL TOWNSEND.

In two patents Mr. Charles J. Reed, of Philadelphia, covers improvements in the production of chlorine and caustic alkali by the mercury cathode process. The improvements relate both to the form of the cell and to a peculiar arrangement of several cells in series whereby is assured the presence of a sufficient quantity of sodium in the mercury to prevent oxidation of the latter metal in the caustic compartments. Figs. 1 and 2 show one form of construction of the



FIGS. 1 AND 2.—CONSTRUCTION OF REED CELL.

new cell, in which the controlling idea is the distribution of the mercury in both compartments in a thin film over metal plates or discs, thus returning to the early idea of Atkins and Applegarth. The carbon anodes, 26, are immersed in sodium chloride solution, 4, in a cell, 20, sealed at the bottom by mercury in open troughs, 19, and at the top by a cover, 24, with depending flanges, 25. The cathodes, 21, which may be grooved discs of copper, are rotatably mounted on the shaft 22, and dip into mercury, 3, contained in a series of transverse troughs communicating with the lateral troughs, 19. By the rotation of the cathode discs the mercury is taken up by the groove 23, distributed evenly over the surface of the discs, there becoming charged with alkali metal, and the resulting amalgam is collected by the mercury in the troughs; this amalgam then flows through the troughs 19 to the oxidizing cell, precisely similar in form to that illustrated, there to function as anode and be denuded of its alkali metal.

In this cell, as in the Castner type, the mercury acts as a bipolar electrode, constituting the cathode in the decomposing compartment and the anode in the oxidizing or caustic cell. If, however, the entire current passing to the mercury as cathode passes also from it as anode, some danger is incurred of oxidizing the mercury as well as the sodium. In Castner's original construction this was guarded against by such electrical connections as would insure a slight excess of current in the decomposing compartments. In Kellner's modification provision was made for short-circuiting a fraction of the current in the oxidizing cell, thereby assuring the same preponderance on the decomposing side. Reed accomplishes the same result by the series arrangement of the cells diagrammatic-

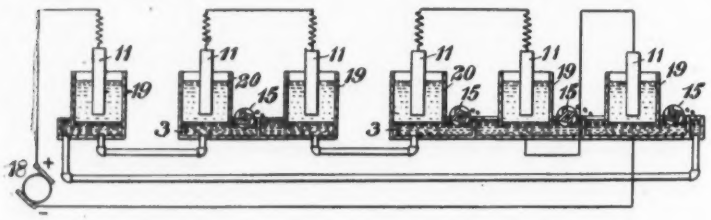


FIG. 3.—CELLS IN SERIES.

ally shown in Fig. 3. The direct connection through the mercury, 3, is broken at four points by transfer devices 15, and the current carried around the gaps by circuit 11, as shown. It follows that the four cells indicated by the numeral 19 are decomposing cells in which the amalgam is produced, whereas in the two cells marked 20, the amalgam functions as anode and the oxidation of the sodium to caustic occurs. Since all cells are connected in series, and since the number of decomposing cells is in excess of the number of oxidizing cells, it is clear that an excess of sodium above that required for carrying the current is insured, and that no oxidation of the mercury can occur.

ELECTRIC COMBUSTION FURNACE.

By providing an electrically heated combustion-tube for carbon determinations, Mr. William M. Carr, of East St. Louis, Ill., adds to the growing list of laboratory appliances controlled by the current. The usual combustion-tube, carrying at one end a roll of copper gauze and at the other a body of granular copper oxid held in place by perforated platinum discs, is surrounded by a porcelain or other tube upon which the coils of the heating circuit are wound. A suitable nonconducting jacket, as magnesia, encloses the whole, and the material for analysis is placed in the usual platinum boat in the center of the combustion-tube. The heating circuit is divided, the ends of the tube being surrounded by two coils connected in series, and the central section by an independent coil; a switch and contacts are so arranged that the current may be sent first through the end coils to bring the copper and oxid to the necessary temperature, and then through all coils in series to provide an evenly distributed heat. During the entire operation a current of oxygen passes through the tube, and the products of combustion are led through the usual collecting train. The advantages of cleanliness, ease of control and quick application of heat, all tending to rapidity and accuracy in the determination, are with this device.

ARTIFICIAL CAMPHOR.

Owing to its interest, reference may also be made to the new method developed at Niagara Falls, for the production of artifical camphor—a method which has, however, no electrical side. Under this name a compound known to chemists as pinene hydrochloride, and having the odor but not the valuable technical properties of camphor, has been noted in chemical literature. We have now a true artificial camphor, prepared by the action of oxalic acid upon turpentine, and capable of replacing Japan camphor in its various uses in the arts. This process, which is among the most original yet credited to American chemical research, is due to Nathaniel Thurlow, of Newark, N. J., his patent, issued April 29, being the property by assignment of the Port Chester Chemical Company, of New York.

Briefly, the method is as follows: Turpentine of a suitable grade, *i. e.*, consisting largely of either laevo or dextro-pinene, is gently heated with anhydrous oxalic acid, in proportion of five parts by weight of dehydrated turpentine to one part of the acid. There results a mixture containing camphor, borneol (Borneo camphor, related to common camphor as an alcohol to a ketone), and the formate and oxalate of borneol. Caustic lime in excess is added to break up these ethereal salts, and by distillation with steam, camphor and borneol are carried over. By a well known reaction the borneol is then oxidized to camphor, which requires purification only to fit it for commercial use.

This is not the first synthetic production of camphor, rather the first method which has seemed to offer commercial possibilities. The hydrochloride above referred to may be converted by weak alkali to the compound camphene capable of yielding camphor by oxidation.

The claims of the patent are limited to the employment of turpentine as raw material for conversion, although the specification states, as indeed would seem probable, that any product containing a sufficiency of pinene may be used; the oils of juniper, eucalyptus, sage, etc., possess this terpene as their chief constituent.

Wireless Telegraphy in London.

A special cable dispatch from London, May 10, to a New York daily newspaper says: The Slaby-Arco Wireless Telegraphic Syndicate has opened an office in London and is preparing to start business in opposition to the Marconi syndicate. The latter is considerably perturbed and is considering the advisability of taking legal action to maintain the validity of its patents. Mr. Marconi is adverse to going to law, preferring to rely on what he contends is the superiority of his system and the cast-iron 14 years' agreement which gives him a monopoly of the use of Lloyds signalling stations.

Duncan Meter Patents.

While not breaking the record set several years ago by an issue at one time of more than 100 telephone switchboard patents to one inventor, the issue of last week of 57 meter patents to Mr. Thomas Duncan, of Lafayette, Ind., makes a record that is a good second. All of the patents are assigned to the Siemens-Halske Company of America.

Of the patents issued, 15 are for improved means of obtaining a magnetic field (in the shunt or pressure coil of single-phase wattmeters), that is 90° behind the impressed electromotive force, or in quadrature with the magnetism of the series or current field coils when the latter are traversed by a non-lagging current. This condition permits of these meters being used to measure the real or true watts on loads of any power factor. The numbers of these patents are 698,638, 698,639, 698,659, 698,652, 698,650, 698,649 698,646, 698,644 698,643, 698,642, 698,637, 698,641, 698,693, 698,640 and 698,669.

Patents Nos. 698,667 and 698,668 are also improvements in single-phase integrating wattmeters, but are designed with the object of reducing the cost of manufacturing to the lowest limit consistent with accuracy of registration. Nos. 698,654, 698,658, 698,660, 698,662 and 698,663 are improvements in two-phase wattmeters, and Nos. 698,664 and 698,674 improvements in three-phase integrating wattmeters. Nos. 698,655, 698,656 and 698,657 are on induction-type indicating and integrating meters, for measuring the so-called "wattless" component; while Nos. 698,665 and 698,666 are for the same purpose, but of the commutated type. No. 698,691 is a commutated meter which measures both the "real" watts and the "wattless" or magnetizing component, and Nos. 698,670, 698,671 and 698,672 are meters of the induction type for accomplishing the same result. Nos. 698,673 and 698,675 show means for eliminating or compensating for the inductance in the armature windings of commutator wattmeters when extreme accuracy is required in the measurement of alternate currents. Nos. 698,676, 698,677 and 698,689 are for improvement in commutated wattmeters used for the measurement of very heavy currents, and belong to the double-armature type.

Nos. 698,651 and 698,648 are for series transformers, used in connection with measuring instruments, and are designed with the object of eliminating the errors incident to this type of transformer by causing the ratio of transformation between primary and secondary to give a straight line characteristic instead of a rising or increasing one, as is usually given by transformers of this type. This improvement allows the instruments to give a true measurement of the energy passing through the primary of the transformer. No. 698,686 is for an improved means of indicating the line loss or drop without the use of pressure wires in an alternating-current system of distribution, and comprises a compensating transformer with three windings; one in shunt to the pressure mains, one in series with the main line, and the third receiving currents by induction from the resultant action of the two former, and having its terminals connected to a voltmeter which indicates the line pressure at the center of distribution.

Nos. 698,679, 698,680, 698,681, 698,682, 698,683, 698,684, 698,685 and 698,687 cover a variety of voltmeters and systems for indicating the drop in volts over the supply mains and means for maintaining the proper pressure at the center of distribution. No. 698,678 shows a commutated meter, with means to prevent sparking at the brushes. No. 698,647 is an indicating instrument for direct currents, arranged to be dead-beat in its action by having the movable coils wound upon an aluminum drum that is embraced by the poles of a permanent magnet.

No. 698,661 is an integrating wattmeter, designed for use in connection with electric vehicles or other purposes or places where there is a great deal of jar and vibration. The moving parts of this meter are very light, and the wire around the armature is in the form of an inverted cup, within which is situated a stationary laminated iron core to draw the flux through the armature coils. The retarding elements of this meter are well protected from the series coils by having a magnetic shield interposed between the series coils and the permanent magnets. This arrangement insures permanency of the retarding magnets, and is very necessary where extreme accuracy is desired. No. 698,688 is an induction coulomb meter, and is constructed with its motor and retarding elements combined, and placed in a detachable receptacle containing oil. Accuracy and cheapness being the main points of the patent.

No. 698,653 is a commutated motor-meter, the principal features of which are means whereby the several parts of the meter may be taken apart for the purpose of cleaning, repairing and recalibrating. Patent No. 698,690 shows another meter of the commutated integrating type with field coils and armature, having cores of comminuted magnetizable material, such as iron-filings, with the view of keeping down hysteresis and retentivity where iron is used. No. 698,692 is also an integrating wattmeter, but of the oscillating type. It comprises, with means for renewing the current in the shunt circuit, an armature consisting of two coils placed at right angles and moving through ninety degrees within suitable series coils carrying the main line current.

Since describing specifically all of the foregoing patents would require more space than is here available, only a few of the more important ones will be noticed below in detail.

Patent No. 698,640 is an induction motor-meter, capable of measuring the true watts on any frequency in commercial use, with both inductive and non-inductive loads. In meters of the induction type, it is a well-known fact that their shunt or volt field magnetism must be in quadrature with the line electromotive force to enable them to measure inductive loads correctly. The means in most common use to produce this magnetic quadrature is that of lagging a derived current that supplies the shunt or volt field coil to as near ninety degrees as possible; then supplementing said field coil with another coil carrying a current that lags 180 or more degrees behind the line pressure; then adjusting the strength of the current in the latter coil until the resultant magnetism of the two coils is in quadrature with the impressed or line electromotive force. In this patent the supplemental coil, carrying a lagging current of, approximately, 180 degrees, is dispensed with, and in its stead is employed an adjustable solid or unlaminated iron or steel core, placed within the volt field-coil proper. When the volt or pressure coil is placed in series with an inductance coil and has the current therein lagged to as nearly 90 degrees as is practicable, the action of the solid core, through hysteresis and reluctance, is employed to further lag or retard the magnetism to exactly 90 degrees. It is also possible with this combination to make the meter measure upon widely different frequencies with a very small percentage of error, something which is very desirable among the central station fraternity, where they often have two different frequencies in use, and are compelled to carry meters in stock specially tested for each of these frequencies.

Patents Nos. 698,655, 698,656 and 698,657 are meters which may be classed as new in the art, and consist of a means whereby a measurement of the "lagging" or "wattless" component may be made. The importance of a means for measuring accurately and instantly the lagging component of the current is apparent in central stations which supply alternating current to motors of considerable size and number. The difficulty in regulations which is experienced under these conditions does not arise from the amount of energy which these motors require, which is, as a rule, no more than that of direct-current motors carrying the same load, but from the influence of the "lagging" or "wattless" currents resulting from the various inductances of the circuit.

Even when the lagging current is measured by a comparison of volt-amperes with watts indicated by instruments of the same type and comparatively calibrated, accurate results are not obtained. For example: if the apparent watts or volt-amperes exceed the true watts by only one per cent., it means that there is upon the line a wattless or magnetizing current with a strength fully 14 per cent. of that of the energy current. If the excess is two per cent., the magnetizing current is 20 per cent. as great as the energy current; that is to say, if the true watts are 100, and the apparent watts 101, the lagging component, which is found by taking the square root of the difference of the squares of the true and apparent watts, will be 14; and if the true watts are 100 and the apparent watts 102, the lagging component will be 20. From these illustrations it will be apparent that very great and disturbing variations of the wattless output affect but slightly the indicated volt-amperes. These three patents show three different ways of measuring the lagging component, all of which, however, provide means whereby the currents in the series and shunt coils are exactly in phase when the load of the main current is non-inductive.

Patent No. 698,665 is also for measuring the magnetizing component, but is a commutated meter, while the three foregoing are of the induction type. In this meter the shunt circuit is provided with means whereby the armature is supplied with a current that is 90 degrees behind the line pressure. This 90 degrees lagging current

is obtained by winding two coils upon a laminated iron core, one of said coils being in series with the armature. The other or second coil is connected in series with an adjustable non-induction resistance and having its terminals in shunt to the work circuit. The current through the first coil, that is, in series with the armature lags to as nearly 90 degrees as practical; then the other coil upon the same core, and which is in series with the non-inductive resistance, acts as a primary, and induces in the first coil and armature circuit a secondary electromotive with a current that lags, approximately, 180 degrees or more, thereby giving in said armature circuit a current which is the resultant of two currents, and is adjusted to exact quadrature by means of the variable resistance in series with the second coil.

Patents Nos. 698,670, 698,671, 698, 672 and 698,691 are double meters, and are so constructed that they may be used to measure or indicate either the true watts or the magnetizing component. The instruments consist of series coils, rotating armature, and double shunt coils, one of which is traversed by a current in phase with the line pressure, the other lagging 90 degrees behind the line pressure. Each of these shunt circuits is provided with a switch or depression key, so that either reading may be taken in an instant. In this manner the difference between the real watts and the magnetizing component may be had by simply depressing one key, noticing the reading or indication; then releasing this key and depressing the second one.

Among the patents for meters to measure very heavy currents, possibly No. 698,677 is the most unique. It consists of a cast-copper field, which is in the form of the letter S, and has two armatures—one within the upper curve and another within the lower curve.

Kelvin at Edison's Laboratory.

Lord and Lady Kelvin were conducted to Orange, N. J., on Friday, May 9th, by Mr. and Mrs. W. S. Mallory, representing Mr. Edison. Mr. J. W. Lieb, Jr., associate general manager of the New York Edison company, was invited to accompany the party. They were met at Orange by Mrs. Edison, and drove directly to Mr. Edison's residence at Llewellyn Park. The beautiful and balmy spring day made the lawns and shubbery of the Edison place look particularly attractive, and the party enjoyed the walk around the grounds.

The laboratory addition to the house, which Mr. Edison has recently built, and in which he is now conducting researches and investigations, was next visited, and Lord and Lady Kelvin enjoyed the explanations of the several lines of experimental work which Mr. Edison, with the co-operation of Mrs. Edison, is pursuing.

Adjournment was taken for luncheon, at which Lord and Lady Kelvin, Mr. and Mrs. Edison, Miss Madeline and Master Edison, Mrs. Colgate, Mr. and Mrs. Mallory and Mr. Lieb were present. It can well be imagined that the subjects of conversation coupled in wonderful harmony a genial flow of humor, good stories and scientific lore.

The party then repaired to the Edison laboratory at the foot of Orange Mountains, and were shown through the shops for the construction of experimental apparatus. Mr. Edison explained in detail the construction of his new storage battery to Lord Kelvin, while Mrs. Edison displayed an intimate knowledge of the details in her explanations to Lady Kelvin. A number of experiments with the phonograph were shown, including its operation backward, with the production of a new language and wondrous feats of euphonic composition. It is needless to say that the party was very much interested in the battery and other inventions. An inspection of the phonograph works closed a most interesting visit, the party returning to New York late in the afternoon.

Electrocuting Old Horses.

A cablegram says: No wonder horses are so frequently electrocuted in Paris. Three clever swindlers were arrested this week in the act of leading a worn-out hack to a spot where they had previously unscrewed a cap at one of the electric "plugs," where the animal was to meet its doom. The practice was proved to be an habitual one. An old hack is bought for a mere song, led to the death trap and a heavy claim for damages is served upon the tramway company. The chief culprit is a former tramway employe.

Fire Losses and Causes.

Some interesting data as to fire losses and causes is given in the Insurance Chronicle fire tables for 1901, a handsome volume of 475 pages, giving the statistics for 1900. It may be noted that in view of the universal tendency of American reporters—and others—to attribute every big, mysterious fire to a "defective wire," electricity comes off pretty well, as it may be taken for granted that "electric fires" include most of those set by firebugs and due to arson. It would be interesting to have the loss of life due to the use of the various illuminants in the same period.

Fire Losses in the United States During 1900.

Cause.	*No. of fires.*	*Loss due to fire.*
Coal:		
Defective flues	12,595	$9,394,410
Stoves	3,013	1,712,830
Locomotive sparks	1,287	2,123,925
Ashes and hot coals	860	661,940.
Furnaces	832	3,951,765
Stove pipes	717	304,440
Open fireplaces and grates	461	150,540
Stationary boilers	341	2,476,450
Defective heating apparatus	109	397,075
Smoke stacks	82	374,660
Total	20,297	$21,548,035
Oil:		
Lamp, etc., explosions	2,244	$1,466,760
Lamp and lantern accidents	1,806	1,081,915
Oil stove explosions	719	176,890
Oil, grease, etc., ignition	459	175,115
Oil stove accidents	450	72,490
Oil explosions	183	1,032,665
Total	5,861	$4,005,835
Gasoline, etc.:		
Gasoline stove explosions	$1,302	$305,955
Gasoline explosions	532	397,245
Alcohol and benzine explosions	100	73,415
Alcohol and benzine ignitions	47	113,470
Total	1,981	$890,085
Gas:		
Explosions	410	$738,415
Ignition, gas jets	1,195	391,105
Total	1,605	$1,129,520
Electricity:		
Lights and wires	1,054	$4,120,700

Cause of fire.	*Average loss per fire.*
Electric lights and wires	$3,910
Coal and its applications	1,061
Gas	704
Oil	683
Gasoline	449

FIRES IN DWELLINGS AND TENEMENTS.

Cause of fire.	*No. of fires.*
Oil lamp explosions	1,602
Oil lamp accidents	1,151
Oil stove explosions	560
Oil stove accidents	327
Oil explosions	102
Total	3,742
Gasoline stove explosions	1,078
Gasoline explosions	250
Total	1,328
Gas explosions	161
Electric wires	117

There was a total of 79,249 fires reported in 1900.

Tesla Patents Decision.

The United States Circuit Court of the District of Rhode Island handed down an opinion, May 12, sustaining the Tesla patents, in a suit of the Westinghouse Electric Manufacturing Company against the Royal Weaving Company, of Pawtucket, R. I. The suit was on a preliminary injunction against the infringement of certain patents which the court states were the same as those sustained in a suit against the New England Granite Company, the opinion in which suit was reprinted in our columns at the time. The opinion states that the defendant relied principally on a French patent issued to Dumesnil, Aug. 8, 1884, and on a French patent issued to Cabanellas, April 9, 1885. The contention was that these patents disclosed what was not before the courts in the Granite case, namely, that two single-phase synchronous motors could be coupled together, as for example, by having their armatures mounted on the same shaft; and that these two motors might be run each by its own circuit of alternating currents, which might be supplied either by two single-phase generators so mounted on the same shaft as to give currents out of phase with each other; or that a single generator, such as is known in the prior art, and which furnished alternating currents differing in phase, might have been used as the source of supply. The court considers that the above-mentioned patents, if produced in the Granite State case would not have affected the decisions as to the nature and novelty of the Tesla invention and as to the validity of the patents in suit. Referring to the Dumesnil patent, the court considered that to couple two single-phase synchronous motors upon one shaft, displacing the poles of one armature angularly with respect to the other so that one motor expends its maximum effort while the other expends its minimum effort, does not seem to exhibit the Tesla invention as described and claimed in the Tesla patent. Referring to the Cabanellas patent, the court said that this patent, upon many readings, seems to it to be fairly characterized by the complainant's counsel as "expressed in such obscure and indefinite terms as to be hopelessly unintelligible except in a few unimportant particulars," and as requiring an exceptional exercise of the imaginative powers in translating its phrases into electrical diagrams. The opinion further states that the Dumesnil and Cabanellas patents at best were based upon the use of two motors of an old type having the characteristic defects of such motors, and lacking the characteristics of the Tesla motors. Even if two of these motors can assist each other, by so timing their mechanical efforts that one exerts its maximum effect while the other exerts its minimum effect, the court does not find in such a combination of the two machines the invention of Tesla, nor the rotary field which was apparently conceded by the defendant in prior suits to be proper subject matter of controversy in determining the validity of the Tesla patent. The court decides that the question of infringement seems to be substantially determined by the prior decisions. The questions as to whether the defendant may be permitted to continue temporarily the use of the motors now installed, and if so, upon what terms, were reserved by the court.

CURRENT NEWS AND NOTES.

DR. A. E. KENNELLY has accepted the newly founded chair of Electrical Engineering at Harvard University.

SALE OF POLYPHASE MOTORS.—In a recent suit involving the Tesla patents, testimony was given to the effect that in the period from Jan. 1, 1898 to June 1, 1901, the Westinghouse Company had sold motors embodying the Tesla patent, aggregating 120,000 hp., and that the General Electric Company in the period from March 31, 1896 to the date of the suit had sold induction motors aggregating about 169,000 hp.

AMERICAN STREET RAILWAY INVESTMENTS.—The valuable annual bearing this title, issued as a supplement to the *Street Railway Journal*, has just made its appearance for the current year, being corrected up to as recent a date as April 15. The present handsome quarto volume contains over 300 pages, with the usual liberal allowance of large and small maps, and it is full of data with regard to the financial and physical condition of every street railway system in the country. The preface embodies also a most useful comparative compilation of the gross earnings of no fewer than 246 systems, arranged in five groups, as to magnitude. The astounding fact emerges that with many of the larger roads left out, these properties are earning gross $178,000,000 a year. The total for all the 900 systems must be well above $200,000,000.

GAULARD-GIBBS PATENT VOID.—In a suit against the Stanley Electric Manufacturing Company, the United States Circuit Court for the District of Massachusetts, Judge Colt has just declared void the reissued letters patent No. 11,836 to Gaulard and Gibbs, assignors to the Westinghouse Electric and Manufacturing Company, which covered broadly the use of step-down transformers in systems of distribution. This patent was originally involved in a suit against the Sun Electric Company, and was subsequently reissued. The court in the present suit held that the commissioner exceeded his powers in granting this reissue, and dismissed the bill with costs.

MARTINIQUE DISASTER.—As all the world now knows, the French island of Martinique, West Indies, has been visited by fearful disaster, due to the eruption from Mont Pelee, and the city of St. Pierre now lies a mass of ashes and debris, with, it is said, 30,000 dead inhabitants. The whole northern end of the island has been devastated. The adjoining British island of St. Vincent has similarly suffered from the volcanic eruption of La Souffriere, and reports already 1,600 dead. At St. Pierre, the West India and Panama Telegraph Company's steamer, "Grappler," was overwhelmed and destroyed, and the cables in the vicinity were broken. The French cable steamer, "Pouyer-Quertier," at the island escaped, and cable service has now been repaired, but is extremely slow and unsatisfactory.

WIRELESS TELEGRAPH CONTRACTS.—Gen. Greely, chief of the Signal Corps of the Army, has approved the proceedings of the board of signal officers who have had under consideration the proposals for the installation of wireless telegraphy stations in Alaska. The award for stations at Nome and St. Michael has been made to Queen & Co., of Philadelphia, who will put in the system invented by Prof. Fessenden, an American device. Gen. Greely has also determined to accept the proposal made by the Marconi Company to install a system between Fort Gibbon and a point on the Tanana River, near Bates Rapids. The proposals from the Arco-Slaby Company, the De Forest Company and others were not considered, as none of these companies would agree to install and work their systems for ten days prior to their acceptance by the Signal Corps. It is hoped that the systems will be in working order by Oct. 1 of this year.

ANNUAL MEETING OF THE INSTITUTE.—The nineteenth annual meeting of the Institute will be held at 12 West Thirty-first Street, New York, on Tuesday evening, May 20th, at 8:15 o'clock. The annual reports of the board of directors and of the treasurer will be presented. The committee of tellers will report the result of the balloting for officers of the Institute. Papers will be presented as follows: "Some Notes on European Practice in Electric Traction with Three-Phase Alternating Currents," by Carl L. de Muralt, of Baden, Switzerland. "A Novel Combination of Polyphase Motors for Traction Purposes," by Ernst Danielson, of Westeras, Sweden. An extra meeting will be held on Wednesday, May 28, at 8:15 P. M., at the house of the American Society of Civil Engineers, 220 West Fifty-seventh Street, New York City, which will be devoted to the general subject of Electricity in the Army and Navy. Members of other national engineering societies have been invited to attend, also members of the Society of Marine Engineers and Naval Architects. One of the principal objects of the meeting is to demonstrate the advantage of the government's calling upon the engineering societies for advice in their work, and for this reason officers of the Army and Navy and others especially interested in the subject are invited. There will be papers by Captain John Stephen Sewell, Chief of Engineers, U. S. A.; Lieut. W. Van N. Powelson, U. S. N.; Lieut. Henry George, U. S. N.; Dr. Louis Bell, consulting engineer; Colonel Samuel Reber, U. S. Signal Corps; Lieut. A. M. Beecher, U. S. N.; Mr. Caryl D. Haskins, General Electric Company; Mr. W. M. McFarland (late U. S. N.), Westinghouse Electric and Manufacturing Company, Pittsburg, and others. The offices and library of the Institute have been removed from 26 Cortlandt Street to the seventh floor of the White Building, 95 Liberty Street, one block directly south of the former location.

LECTURE ON THE BUREAU OF STANDARDS.—Prof. S. W. Stratton, director of the National Bureau of Standards, lectured, May 7, before the Western Society of Engineers, at Chicago, on the work of which he is a director. He gave some of the causes leading up to the law of 1901, which established the national laboratory of standards, chief among which he said was the fact that American manufacturers were going abroad for their standards. The plans for the two new buildings, which will be built for this purpose in a northwestern suburb of Washington, D. C., were shown by stereopticon, and, in conclusion, considerable discussion (all favorable) took place as to the metric system and the bill now before Congress. This bill makes the metric system compulsory in the United States government specifications and documents (except as relating to public lands) after Jan. 1, 1904, and makes it the legal system after Jan. 1, 1907, although, of course, anyone can use the old system of measurements after that time if so determined. The interest and attendance at the meeting was gratifyingly large, and a good proportion of the audience were electrical people of Chicago.

STATE ELECTRIC LABORATORIES.—We have noticed in the recent daily press of New York a statement to the effect that a commission has been appointed and has met to consider the question as to whether a state electrical laboratory should be established in New York state, to provide means for testing electric measuring instruments, and keeping standard electric pressures and currents on tap. We sincerely hope that no such state laboratory will be established, as it would be worse than useless expense. The Bureau of Standards at Washington is a National body, charged with doing this precise work among other duties. There is no immediate likelihood of this bureau being so far overwhelmed with electrical work as to be incapable of supplying the demand. No sub-standardizing bureaus should be called into official existence without being annexed to the National bureau at Washington. A number of state electric standardizing bureaus are likely to lead to just as many different values of the volt ampere and watt, besides involving much reduplicated labor and expense. Were the states generally to indulge in the practice, the situation might become particularly unbearable to the manufacturing companies doing business all over the country.

A WATER-PROOF LAMP AND SOCKET.—A patent was issued recently to Lester Thayer, a well-known electrical engineer of Peoria, Ill., upon an incandescent lamp combined with a water-proof socket. In order to get the water-proof socket Mr. Thayer has thickened the glass around the base of the lamp so as to permit of a gasket joint between the glass of the lamp bulb and the socket. The drawing in the patent shows Mr. Thayer's idea as used with the Edison form of screw lamp base. The socket proper can be made of porcelain or other water-proof insulating material capable of being molded or turned to the desired shape. The glass of the lamp bulb at the gasket joint between the socket and the bulb matches with the socket exactly, so as to make a smooth exterior surface, not only neat in appearance, but of a shape not likely to invite the retention of moisture at the socket joint. Mr. Thayer's invention attacks the problem of a water-proof socket for out-door incandescent lamps is an entirely new way, as the gasket joint, if tight, will keep all water away from the screw base of the lamp, and the usual rusting together of base and lamp socket cannot occur. Those who have had much of exterior decorative lighting to do with incandescent lamps where sockets are exposed to the weather, know how common this trouble is.

BOSTON MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The forty-fifth meeting of the American Society of Mechanical Engineers will be held at Boston, Mass., May 27 to 30. The professional sessions will be held at the Massachusetts Institute of Technology, and the headquarters will be in room 14 of the Institute Engineering Building. A very full programme has been prepared for the instruction and entertainment of those in attendance at the meeting. The Technology Club, St. Botolfs Club and the Boston Art Club have extended their privileges to members of the Society during the meeting. Excursions in the city and vicinity have been arranged for the ladies with the party, and arrangements made for a number of professional excursions. Among the papers to be read are the following: "Construction of Atlantic Avenue Power Station, Boston," by I. E. Moultrop and R. E. Curtis; "Liquid Fuel Consumption," by Chas. E. Lucke; "Electricity in Cotton Mills," by W. S. Smith-Whaley; "Some Details of Direct-Connected Generator Sets," by Wm. H. Bryant, and "Elevator Safeties," by Chas. R. Pratt. At the meeting there will be considered the final report of the committee appointed to codify and standardize the methods of engine tests, and a report by Mr. Geo. H. Barnes on tests of steam pipe coverings.

PRIZES FOR AN ELECTROLIER.—The Municipal Art Society of New York announces a competition for a design for an electrolier, to be combined with an "isle of safety," to be placed at the intersection of Fifth Avenue and the south side of Twenty-third Street. The electrolier, when completed, will be presented by the society to the city. It is desired to obtain a simple and beautiful street fixture to serve as an example for future work; by its placing to divide the traffic so as to force it to follow the rules of the road and keep to the right; to supply a place of safety for foot passengers in crossing the avenue, and to give a place for the necessary lighting, signs, etc., for the convenience of the public. The competition will be judged by a jury of fifteen members, ten professional artists and five laymen, and will be open to artists, without distinction of age or sex. Drawings and models must be delivered, addressed to the secretary of the society, at the Architectural League, on or before June 14 next. The first prize will be a commission to execute the necessary full-sized drawings and such modeled details as are required for the execution of the proposed work, for which $500 will be paid. The second and third prizes will be $100 and $50, respectively. The designs shall not call for an expenditure of more than $1,500 for the complete execution of the electrolier.

A MISAPPLIED REVIEW NOTICE.—Some months ago we printed a review of a book entitled, "Recording and Integrating Electric Meters," which only called for notice in our columns on account of its extreme worthlessness, which we pointed out for the benefit of readers who otherwise might have been led to buy the book. Recently we have received from a number of indignant purchasers of the book, a copy of a circular in which this journal is quoted as highly recommending this work, which, as a literary freak, ranks with "English as She is Spoke," and as a technical treatise betrays a profundity of ignorance on the part of the writer which cannot be characterized otherwise than as phenomenal. Upon reference to the review notice, we find that the circular quotes some parts of the same, but divorced from a context far from commendatory. Below we print the first paragraph of the review notice, with the part in italics which the author uses in his circular: *"This treatise is a gem. Not for an instant could the reviewer hesitate to heartily recommend the purchase of a copy to everyone who even imagines that possibly some day he will be interested* in electricity. Those who have as yet forgone a technical education will find the statements in the book so curiously and wonderfully involved that they cannot possibly learn anything from it that would hurt their minds (we say nothing about helping them); while those who are a little further along can get a fair average of two laughs per page out of it, not to mention the aggressively apparent moral of the whole: Refrain from attempting to say what you cannot express, and don't imagine that a smattering of knowledge means mastery of a subject."

LETTERS TO THE EDITORS.

The Heyland Motor.

To the Editors of Electrical World and Engineer:

Sirs—I have just seen the letter of Mr. H. St. Martin, which appears in your issue of Dec. 28, 1901, in which Mr. Martin says that priority as to the form of a synchronous motor, known as the Heyland motor, and so described in your journal, must be conceded to M. Latour.

This is evidently the result of a misunderstanding. M. Latour's publications refer to quite another subject, as will be seen by refering to the ELECTRICAL WORLD AND ENGINEER, of April 12, 1902 (p. 658), and *L'Industrie Electrique,* of May 10, 1902.

For the motors of my system, as they were described in the ELECTRICAL WORLD AND ENGINEER, of Aug. 31, 1901 (p. 347), and of Jan. 4, 1902 (p. 34), I have applied for patents in Europe and America; the German application has already been accepted by the

Patent Office. I may add that most of the important European manufacturers of electrical machinery have already taken licenses under my patents.

BRUSSELS, BELGIUM. A. HEYLAND.

Improvement of the Telegraph.

To the Editors of Electrical World and Engineer:

Sirs.—Concerning the complaints made from time to time that few improvements are applied in telegraphy, the cause is very plain to my mind. Consider the manner in which a telegram is sent and received. A person, often in a hurry to have his message delivered, comes to a telegraph office, usually takes one of its blanks and writes the message; this is sent to the operator, who, while reading, transmits, and it is rewritten (likely much faster than it was written by the person sending) by the operator at its destination. It is then sent out and delivered.

What can be quicker than that? It is true it possibly might be written by the person sending, on some prepared paper and photographed at the other end, but it has hardly come to that yet. If the message is to be sent by some rapid process, it has to be read and arranged to suit; while that is being done, it could be at its destination and delivered, or on its way to delivery. As a general thing, the telegraph lines allow messages to be received as fast as they can be sent, which is not at all slow; and no improvement can do more. In my opinion, the telegraph is the most complete of all electrical arrangements.

BALTIMORE, MD. ALFRED G. DELL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Self-Exciting Alternators.—HEYLAND.—An article in which he explains the differences between his self-exciting non-synchronous alternator and the self-exciting shunt-alternator of Latour (both of which have been noticed in the Digest). Latour's shunt alternator consists of a stator with three-phase winding and a rotor like a direct-current armature, with three brushes supplying the three-phase currents to it. All these parts agree exactly with a non-synchronous three-phase motor, devised by Georges, in 1891. This motor gave good results; it had even at synchronism a certain self-excitation which was shown by the fact that at this speed the phase-difference between current and e. m. f. disappeared. But Latour has found that such a motor can be equally well operated as generator, and this he has patented. On the other hand, Heyland's alternator is characterized by the fact that it belongs to the type of induction machine with an armature winding closed in itself. It is known that such machines can be operated as motors as well as generators. There exist different methods for self-excitation of such alternators, and the object of Heyland's invention is a new method of self-excitation characterized by the new device of introducing magnetizing currents into the rotor winding closed in itself. In Latour's shunt alternator the currents induced in the rotor by the revolving field will be communicated to the network through the brushes. The proper operation is with zero slip, which Latour can accomplish by adjusting the brushes; at the same time it will be necessary to increase the exciting current. The slip when it is produced will be greater than in Heyland's alternator, in which it will remain within ordinary limits without any adjustment. The essental difference between Latour's and Heyland's machines is that in the former the total rotor current must pass through the brushes, while in the latter, which is of the induction type, only a part passes through the brushes; namely the magnetizing current, the balance passing through the ring which short-circuits the rotor-winding. Heyland had already remarked that Latour's machine will not work on account of the sparks at the brushes; "for this reason Georges has abandoned his analogous experiments of 1891, and if Latour and Poincare prove, by theory, that the sparks must disappear, I would only say it all depends on the theory which one applies. In practice, they will not disappear." The reason is that a field generated by single or polyphase alternating currents rectified by a commutator, is never absolutely constant, as would be, for instance, a field generated by direct current. In a field produced by rectified alternating currents, there occur—at least in certain parts of the field—oscillations due to the commutation. This can be proved by the following elementary experiment. If, in a direct-current machine, copper brushes are replaced by carbon brushes, it is known that sparks which occur at the copper brushes, will disappear, or at least be diminished. If now the same armature is supplied through three brushes with three-phase currents in synchronism with the angular speed of the armature, there is no appreciable change in the sparks, when carbon brushes are substituted for copper brushes. This is explained by the oscillations produced by the commutation of the alternating current. These oscillations represent a certain amount of energy which must be destroyed by the rupture of the circuit, and which manifests itself in the sparks at the brushes. Evidently the material of the brushes can here make no difference whatever, while in direct-current machines the only phenomenon to be considered, the effect of the short-circuiting of two adjoining segments, undergoes variations when the material of the brushes is changed. Hence in the Latour machine the sparks cannot be suppressed. This is the reason, and the only reason, while all commutator motors, which he calls conduction motors (evidently to distinguish them from induction motors) are unsuccessful for alternating currents, in spite of the great number of particular good properties. On the other hand, such oscillations do not exist in induction machines. They are suppressed by the damping (amortisseur) effect of the short-circuited rotor winding. The practical consequence of this fact, utilized in the Heyland alternator, does not seem very evident at first sight, and it seems even paradoxical to combine a commutator with a winding which is short-circuited in itself; it would seem that currents could not be introduced into a winding closed in itself, or, at least, that when they enter their magnetizing effect would be zero, on account of the opposite direction which they would take; as they are alternating currents, it would seem that they must produce short-circuited currents in the winding which would prevent any production of a magnetic field. This apparent impossibility explains why for 12 years, since Georges' experiments, experiments have been made in this line, without the very simple idea of introducing alternating currents into the short-circuited armature of induction motors. The new idea of Heyland's invention is, therefore, to introduce, by means of a commutator, alternating currents for excitation into the rotor of an induction machine, although the winding is short-circuited. This is done by the use of an armature short-circuited in itself by means of a ring of a certain resistance which at the same time serves as commutator. In practice a single ring cannot be used because there does not exist a material of suitable resistance. A ring consisting of a number of segments connected together by electric conductors is therefore used, the resistance of which has a certain relation to the resistance of the winding. Such a commutator becomes very simple on account of the small number of segments which can be used without any danger of sparks being produced. This shows why a commutator, while inadmissible for any other type of alternating current machines, does not present any inconveniences when used on an induction machine with short-circuited rotor. The field in the rotor is absolutely constant, as though it were produced by direct current. Hence there are no oscillations of the field, no extra-currents, no sparks at the brushes. The short-circuited rotor winding represents an excellent damper (amortisseur) against any oscillation of the field. The commutator behaves like a single solid ring, which it is, in principle. For all positions of the brushes, there are no sparks. In recent designs he uses three or four segments for the distance between two brushes, while in direct-current machines 20 to 30 are generally used. The novel result obtained is, therefore, the excitation of a constant field without oscillations in the rotor, by means of rectified alternating currents. The difference between Heyland's and Latour's machines becomes more evident for single-phase currents. Boucherot has found that in Latour's

machine, single-phase, alternating current does not produce any effect. On the other hand, the first Heyland machine actually built, and which has given perfect results, was excited by single-phase currents.—*L'Ind. Elec.*, April 10.

Latour.—A brief reply to Heyland's article. He objects to Heyland's historical notes (about Georges), and says that never before has a shunt alternator been constructed. Concerning Heyland's device, he say that the network, as a whole, will in any case have a much smaller resistance than the resistances placed by Heyland in parallel with the excitation circuit.. Hence, through the "short-circuiting" commutator ring only a very small portion of the currents induced in the rotor will pass; the circuits of the currents will be largely closed through the brushes. The resistances between the segments cannot be considered as a short-circuiting ring, but ought to be considered as shunts introduced to avoid sparks. "Heyland must have noticed that the motors subjected to his tests could turn at and above synchronism; he will agree that these are induction motors of a very special kind." He thinks that Heyland's and his machine are of the same type. Heyland applies only a special device for avoiding sparks. He says he can do without Heyland's device, as the troubles in the commutation are due only to the harmonics of the field and can be avoided.—*L'Ind. Elec.*, April 25.

REFERENCES.

Variable Speed Motor.—An illustrated description of a shunt-wound motor, the field magnets of which are hollow and contained within them are closely fitting iron plungers, which, by means of gearing, may be moved toward or from the armature, so that the reluctance of the magnetic circuit may be varied at will. The motors are said to have an operative speed range from normal or minimum speed to from 100 to 150 per cent. above minimum.—*Eng. News*, May 1.

Direct-Current Motors.—McCormack.—A discussion, by means of simple mathematical formulas, of the effect of variation of field on power and speed of a constant potential motor.—*Elec. Rev.*, April 26.

Alternating-Current Engineering.—Behrend.—An illustrated article on the development of alternating-current engineering.—*Cassier's Mag.*, May.

Lights and Lighting.

Interior Lighting.—Smith.—An illustrated article giving the results of a study of certain shades and globes for electric lights, as used in interior illuminations. He speaks very well of Holophane glass; the efficiency of the globes is excellent, the light can be thrown practically in any desired direction, and the diffusing action is practically perfect; they also excel in the uniformity existing among individual globes of the same type, and in the precision with which they allow the determination beforehand of the results to be obtained. He describes a method of determining the illumination on a surface and gives the results of an application of this method to a special case, the results being discussed in detail. It is just as easy to calculate what the result will be in simple cases, using opal globes, ground glass balls, etc., as with Holophanes, because the distribution curves are similar in different azimuths; but it is not so simple to calculate and produce a given scheme, because one does not have the same effective method of producing various distribution curves in the same character of globe, and of combining these according to necessities of the case. Similarly, one can by many types of reflectors produce distribution curves as desired, but diffusion is either absent or imperfect; and in many cases the distribution curves differ in different shades and in different azimuths in the same shade, so that each shade strictly ought to be adjusted to exactly the desired position and then always returned to the same. With the Holophanes all this difficulty is avoided.—*Tech. Quart.*, March.

REFERENCES.

Railroad Car Lighting.—A description of the electric lighting equipment of the railroad mail cars of the German Post Office. The current is obtained from storage cells which are placed into the cars, after they have been fully charged.—*Elek. Mittheil.*, March.

Incandescent Lamp.—A well illustrated description of the works of the Sir Hiram Maxim Electric & Eng. Co., Ltd., and of the actual processes involved in incandescent lamp manufacture. The filament used in the Maxim lamp is made from cellulose, obtained from Japanese paper and other material by a secret process.—Lond. *Elec. Times*, April 24.

Power.

Small Water-Power Transmission Plant.—Hardesty.—An illustrated description of a small water-power electric transmission plant for local lighting service in Utah County, Utah; this is considered as a good example of what could be done in utilizing the natural fall of many mountain streams in the West for the benefit of neighboring settlements. There is at present installed a 250-kw, 60-cycle, 6,600-volt, three-phase generator. The current is transmitted to a substation 5 miles distant, where the voltage is reduced to 2,000. From there the current is transmitted to different places for lighting and power, 115 to 200 being the voltages used respectively for these purposes. The hydraulic installation is described in detail.—*Eng. News*, April 17.

REFERENCES.

Alternating Current Transmission.—Sturdevant.—A reprint in full of an illustrated paper read before the Cleveland Electric Club. He first gives a general graphical review of the phenomena taking place in alternating-current circuits, and then makes an application to a simple numerical case of power transmission. No use is made of higher mathematics.—*West. Elec.*, April 19, 26, May 3.

Boilers.—The whole issue, of more than 100 pages, consists of a profusely illustrated description of American stationary boilers and furnaces and feed-water heaters, compiled apparently largely from trade publications.—*The Eng.*, April 15.

Traction.

Electric Traction on Normal Railroads.—Huber.—A paper read before the Engineers' Club of Zurich (the author is a director of the Oerlikon Co.); he refers to electric traction under steam railroad conditions. He says that, while single cars running at short intervals are suitable for passenger service, electric traction on normal railroads has to take care also of the freight traffic and handle the transfer of heavy freight trains between different main or branch lines. For these reasons he believes the electric locomotive must be used. To insure economy of operation, a high voltage must be used; this is said to make the use of three-phase currents prohibitive, as two overhead contact wires would be required, and they would not be insulated sufficiently to fulfil all requirements of safety. Only a single overhead contact wire can be considered reliable. He therefore recommends single-phase alternating current for transmission. This alternating current is converted into direct current by a motor generator placed on the locomotive, and this direct current is supplied to the motors.

The direct-current side of the motor-generator is separately excited, which gives an excellent method of speed regulation, starting and braking, and returning power to the line on descending grades. Such a system has been proposed before by Ward Leonard, and recently by Mordey. The Oerlikon Co. has worked out the practical details of the system, and has recently made an offer to the Swiss Railway Department to install the system on a road of its network. A locomotive is being built with four axles, for receiving alternating current at 15,000 volts, for a capacity of 700 hp at the drawbar, the total weight being 44 tons. This shows that such a locomotive is not too heavy. To drag a train of 250 tons weight, with a speed of 40 kilometers, on a grade of 1 per cent, about 565 kw are required, which, for 14,000 volts and a phase difference of 10 per cent, means that 45 amp. are to be taken off from the contact wire. This current is not excessive. The only serious objection of the use of alternating current for traction with rail return is the reactance of the rails, which causes too high a voltage loss, if the frequency is, say, 42 periods (Burgdorf-Thun). He believes that although the weight and the cost is thereby increased, it will be necessary to use a lower frequency, say 16 periods. He gives numerical calculations which show that the losses are small on a long line which is equipped with this system and on which several trains are running at the same time. The feeding points are proposed to be placed at distances of 120 km. He thinks that a lower voltage than 15,000 is insufficient and a higher voltage undesirable, as 15,000 volts is said to be the highest e.m.f. which can be produced directly in machines with safety and without special difficulties. The Oerlikon Co. has worked out a new system of suspending the contact wire, which gives a very great freedom in its alignment; it runs at the side of the road, and the trolley poles slide along it, being movable around an axle in the direction of the car and being pressed upwards by a spring. He claims that the arrangement of the switches becomes very simple. Illustrations

are promised in a future publication. He thinks that for traction in general, with the exception of high-speed roads and track and pinion mountain roads, the use of any other but direct current for feeding the motors is wrong.—*Schweiz. Banzeit.*, v. 39, Nos. 10, 11, 12.

Berlin-Zossen High-Speed Railway.—A rather full account of the most interesting results obtained on this experimental railroad, the equipment of which has been described in detail in ELECTRICAL WORLD AND ENGINEER. The problem of the current feed to the carriage seems to have received a successful solution; the pressure of the contact bows against the trolley wires amounted to 4 or 6 kilograms; there was very little sparking at the contact devices, in spite of the high speed of 130 ft. per second; where sparks appeared they would be traced to slight defects in details. When starting for a speed of 60 miles full speed was reached within 1.2 to 1.8 miles, the acceleration being from 5 to 8 ins. per second; these accelerations are not high; on the Elevated and Underground Electric Railway of Berlin the acceleration is 24 ins. on starting. Since, however, rapid starting wears the locomotives considerably, and since the stations will not be very close on high-speed lines, the question of rapid and reliable braking is of much more importance than that of rapid starting. The cars are fitted with Westinghouse air brakes, with hand brakes and with counter-current brakes. The General Electric Company of Berlin furthermore added an electromagnetic brake, fed from an independent source of current—a special battery of storage cells on board. The Westinghouse brakes could exert a pressure equivalent to 3,640 kilograms, equivalent to 95 per cent. of the weight per brake-block. The brake ratio was 1 : 1,002. Both the time and the space interval of the Westinghouse brakes were determined, the air pressure being 6 atmospheres. The original appliances did not answer, and the valves had to be altered in the course of the experiments. As the brake-blocks, and also the wheel tires, became very hot, experiments were also made with hollow, water-cooled blocks. It will be found advisable for high speeds to apply brake discs to the axles and not to let the brakes act directly upon the wheels, lest the tires should slip. The hand brakes are, of course, used for emergencies. The cars could be stopped within 2,350 ft., and the retardation amounted only to 2 ft. per second. Braking by current reversal is not to be recommended, as it endangers the motors. The conclusion arrived at is that further means of efficient braking will have to be devised. The results of the brake tests are summarized as follows: When the speed in miles was 96.5, 68.5, 68.5, the brake interval was: the space in miles 1, 0.31, 0.34, the time in seconds 67, 35, 32, respectively. Figures are given for the energy consumption, which show an efficiency of 90 per cent. for the motors, 85 per cent. for the electric installation and 45 per cent. only for the whole plant; but the power station was further off than it would be in a special railway plant; it would be futile to base any estimate as to working expenses on these tests. The rise in the air pressure did not extend beyond a distance of 11 ft. in front of the carriage; the rounding off of the carriage on the sides and at the roof was found to be a very important feature. No particular increase in the pressure was noticed on the rear portion of the car, nor was any noteworthy suction effect observed in the wake of the car. When the speed exceeded 75 miles, the signals could no longer be well distinguished, and the rain striking the windows interfered very much with the visibility of the signals. The latter will, therefore, have to be made very large and clear, and will have to be placed quite a mile in advance of their "destination." It is also intended to try signals on board, to be actuated from the signal boxes, and to repeat the respective signals by bells along the track. While the experiments do not allow a final opinion to be passed upon electric high-speed traction, they have been sufficiently satisfactory to justify a continuation of the work after the roadbed has been improved.—Lond. *Eng'ing*, April 25.

Automatic Block Signals on Heavy Electric Railways.—An article discussing automatic block signals as used on elevated railways. The first system described is that used in Boston. One of the track rails is used as a return, and the other rail is lai din insulated sections, and is used as part of the circuit for operating the block signals. As the structure itself is of iron, there is plenty of metal in the return circuit when only one rail is used as a return. As will be seen, the system is operated by a 100-volt circuit. In connection with the block signal system an automatic train stop is used. If the car should pass the signal of danger, a valve connected with the air brakes is opened by a trip located alongside of the track, and the brakes are automatically set. The block signals used on the Chicago elevated lines are then discussed. Unlike the Boston system, the cars themselves provide the power for operating the signals by running over a treadbar which winds up a spring. The mechanism used to operate the semaphore is electricity, and in case a motorman fails to regard the danger signal, the brakes will be applied in the same way as at Boston. The current for operating the semaphore is taken from storage battery cells.—*St. R'y Jour.*, April 5, and Int. Ed., April.

WIRES, WIRING AND CONDUITS.

Notes on Wiring.—BROADBENT.—An article in which he refers to the fact that electrical fires are now of comparatively rare occurrence in England, although the wiremen do not generally follow the many conflicting wiring rules in existence. He remarks that an electric fire may be the result of, rather than in spite of, wiring rules. He refers to a case in which a fire was due to the methods of earthing an interior wiring, both of which were in accordance with the Board of Trade requirements. He recommends taking good care in making earths, and suggests connecting together at frequent intervals all water pipes, gas pipes, lead and steel sheathings, and every other underground metal conduit; the leakage current in each would thus be so reduced that electrolysis would not be feared to such a degree as it now is.—Lond. *Elec. Rev.*, April 11.

Air-Spaced Telegraph Cables.—FLETCHER.—An abstract of a paper read before the Manchester section of the (British) Institute of Electrical Engineering. He specifies that the paper covering round the conductor should be whipped with a hemp twine of about ½-in. pitch, and the strength of the paper should be such that a strip 1 in. wide will bear a strain of 4 lbs. for each mil of thickness. For 64-lb. conductors he uses paper 4 mils thick and 1 in. wide; for 150-lb. conductors, 5 mils thick and 1¼ ins. wide; and for 200-lb. conductors, 6 mils thick and 1½ ins. wide. He specifies that the cable must be dried at a temperature not exceeding 225 degs. Fahr., after the wires are laid up and before lead covering. The minimum radial thickness of the lead covering should be 100 mils for a five-pair cable, and not necessarily more than 150 mils for a larger cable, and the lead tube should be capable of withstanding an internal pressure of 75 lbs. per square inch. He recommends that the cable should be tested under an air pressure of 20 lbs. per square inch, and when under this pressure passed slowly through an observation trough at least 18 ft. long and containing water. The insulation resistance specified between wire and wire and wire and sheath is at least 10,000 megohms per mile, and the capacity 0.09 microfarad per mile for 64-lb. conductors, and 0.1 microfarad per mile for conductors of 100 lbs. per mile and over. He calls attention to the necessity of lightning arresters in connection with the wires, as the cables are used in conjunction with overhead wires. It is pointed out that the spark gap in the lightning arrester must be smaller than the air space at any point throughout the cable. There are now about 90 miles of air-spaced cables in use on the London & Northwestern Railway, varying from one pair to forty pair, and representing 1,700 miles of single conductors. They are used underground at crossings over the main lines of rails, on station yards, and in tunnels. They have proven very satisfactory. They are laid "solid" in wood trunking, the trunking being grooved out of solid timber and the groove being very little larger than the cable. He does not approve of the drawing-in system, and instances a case in which the lead sheathing of a ten-pair cable 300 yds. long, after being drawn into iron piping, gained 18 ft. over the conductor. If the lead and conductors are anchored together, he says, there is a tendency towards the production of pinholes in the lead.—Lond. *Elec.*, April 18.

ELECTRO-PHYSICS AND MAGNETISM

Electric Oscillations in Coils.—LUEDIN.—After Hertz's method, it is usual to produce electric oscillations with the aid of sparks. But oscillations may also be obtained by simply closing or opening a circuit in which a coil of a sufficient number of turns is inserted. He detects the existence of these oscillations by means of a coherer simply attached to some part of the circuit at one end, the resistance being measured after each break or make. The effect is greater at break than at make. By substituting a long wire for the coherer and mounting another wire parallel to it, he was enabled to demonstrate the existence of longitudinal waves in both wires. If a coherer is attached to the end of the second wire, its resistance

falls as soon as the current is closed or opened in the primary circuit. But the strength of the resonance depends upon the length of the second wire.—*Ann. der Physik,* No. 3, abstracted in Lond. *Elec.,* April 11.

Velocity of Ions from Hot Platinum Wires.—CHILD.—An account of an investigation of the discharge from a hot platinum wire through which a constant current is flowing. The discharge carried by the positive ions and that carried by the negative ions were studied and compared. The velocity of the positive ions was found to be greater than that of the negative ions. At a certain temperature ionization is produced in the gas about the wire to greater than molecular distances. Experiments on a wire enclosed in a glass tube indicate the presence in the tube of particles which diminish very greatly the velocity of the ions. This "emanation" appears to load the ions, and thus to diminish their velocity, both when they are within an enclosed tube and when they are in the open space. Thus the particles driven off from a hot wire do not appear to aid in the discharge, but to materially check it.—*Phys. Rev.,* April.

REFERENCES.

Induction Coil.—TROWBRIDGE.—An article referring to the theoretical result obtained by Lord Rayleigh regarding the significance of the electrostatic capacity between the primary and secondary of the induction coil, and his proof that in certain cases a condenser in the primary is of no advantage, and sometimes it may be prejudicial. The present author described in detail a powerful coil devised by Heinze to be operated by his liquid interrupter. The performance of this coil justifies the points raised by Lord Rayleigh. —*Phil. Mag.,* April.

Skin Effect in Oscillators.—CHANT.—A long account, illustrated by figures and tables, of an experimental investigation into the skin effect in electrical oscillators. The experiments indicate that, both in the case of cylindrical and spherical doublets, the excessively thin gold leaf shells are quite as efficient as the solid metal bodies.—*Phil. Mag.,* April.

X-Light Tubes.—ROLLINS.—Continuations of his long serial giving "notes on X-light," in which he discusses the construction of tubes for powerful coils, the proper distance of the target from the cathode, the form of target, the cathode, the position of the cathode, the stems of the terminals and the terminal wires, vacuum regulators, the length of X-light tubes, their diameter, the length of terminals and the question of single versus double focus.—*Elec. Rev.,* April 19, May 3.

Discharge Potentials.—TOEPLER.—An account of an investigation of the discharge in air between a point and a plate. There are ten different forms of such discharges, their occurrence depending upon the difference of potential and current as well as on the distance between the two electrodes. The main point is the limiting potential at which the visible discharge sets in.—*Ann. der Phys.,* No. 3; abstracted in Lond *Elec.,* April 11.

Electromagnets.—WAGNER.—An article on attraction by electromagnets. He describes experiments made by Damon, and by Richardson and Witherspoon, and calculates from the same the intensity of induction in the air gap and the pull, under the assumption that there is no spreading of the lines of induction.—*The Rose Technic,* April.

ELECTRO-CHEMISTRY AND BATTERIES.

Soda and Bleach.—RHODIN.—An abstract of a paper, read before the Canadian section of the (British) Soc. of Chem. Ind., on the electrolytic manufacture of caustic soda and bleaching powder at Sault Ste. Marie. The Rhodin cell is used, with a mercury cathode. A storehouse cylindrical vessel, 3 ft. in diameter, with radial openings at top and bottom, the upper ones closed airtight by carbon blocks into which vertical carbon rods are screwed, is supported by a stoneware delivery pipe so as just to dip into a layer of mercury, covered with water, in a shallow cast-iron dish 5 ft. in diameter, forming the cathode. The interior is filled with brine and the dish with water; the cylinder is then rotated; when under a current of 800 to 1,000 amp. and 5 volts, sodium amalgam is formed under the lower slots, and by the turbine action of radial flanges passes to the water in the outer annular space and yields caustic soda, while the chlorine evolved in the cylinder is collected by the delivery pipe. The mercury on losing the sodium sinks and returns to the center of the bell from below. The soda lye is drawn off on reaching a desired strength, and replaced by water. By means of a central entrance and exit tubes, strong brine is supplied just above the surface of the mercury, and the spent, and therefore lighter, liquid is withdrawn at the upper level, to be strengthened and used again. The carbons are of Acheson graphite, with four times the conductivity of ordinary carbon. In the discussion it was remarked that the hearty support which the manufacturers had given to the new American Electrochemical Society showed that the policy of obscurantism in electrochemical industry had been abandoned.—Lond. *Elec. Times,* April 24.

Colors of Electrolytes.—PAULI.—An article "on some color phenomena of dissolved molecules, a contribution to the limitation of the dissociation theory." He discusses the coloring of solutions by the addition of another reagent, for instance, the fact that ferric chloride, after having been diluted to such a degree that it is colorless, gets a yellow color again after the addition of concentrated hydrochloric acid. He says that this has nothing to do with the color of the ions; he explains these phenomena by the assumption of the formation of anhydrites.—*Elektrochem. Zeit.,* April.

Manganese.—HERAEUS.—An account of a determination of the melting point of manganese, 99 per cent. pure, which was found to be 1,245 degs. C.—*Zeit. f. Elektrochemie,* April 3

REFERENCES.

Electrolytic Estimation.—The first of a series on recent researches in electrolytic estimations made in the University of Pennsylvania. The first is by Fulweiler and Smith on the precipitation and separation of silver in the electrolytic way.—*The Elec.-Chem. and Met.,* March.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Speaking Arc and Wireless Telephony.—SIMON.—An illustrated lecture, giving a summary of the experiments of various investigators with the speaking arc. Diagrams are given of different

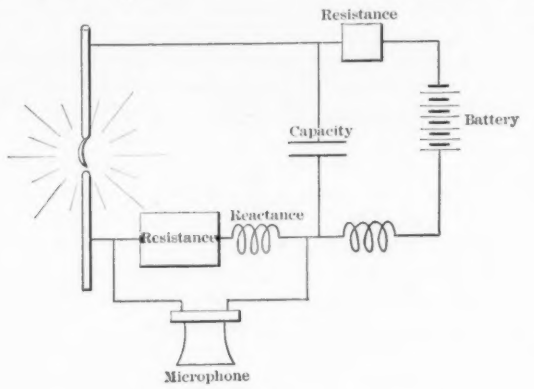


FIG. 1.—SPEAKING ARC.

methods by which microphone currents can be superposed on the direct current flowing through an arc lamp, and the arc is thereby made to reproduce the sounds spoken into the microphone. Technically the simplest arrangement is said to be that shown in the ad-

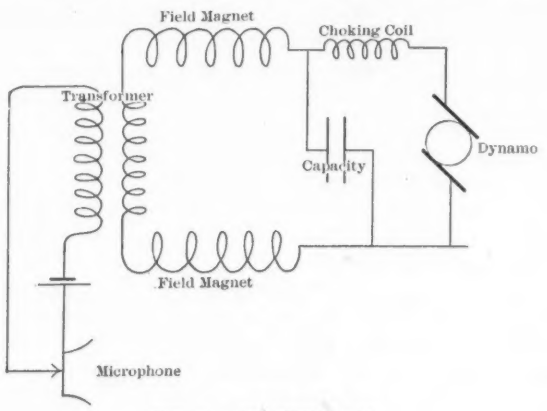


FIG. 2.—SPEAKING ARC.

joining diagram 1. He has succeeded in impressing microphone currents on the field magnet of a direct-current dynamo in such a way that the total network receives the oscillations and all arc lamps connected to the networks reproduce the sounds spoken into

the field magnet microphone; this is accomplished by the arrangement shown in diagram 2. To get loud sounds the length of the arc is important; Duddell uses arcs up to 10 cm length. The reverse of the "speaking arc" is the "listening arc," namely, the phenomenon that when the air pressure acting upon an arc varies in oscillatory way (as in sound waves), there occur analogous oscillations in the current, and these oscillations can be made to reproduce the sounds in a telephone. He discusses the experiments of Duddell, in which a direct-current arc, in parallel with a low-resistance circuit containing self-induction and capacity, begins to sound by itself, under proper conditions; he discusses this phe-

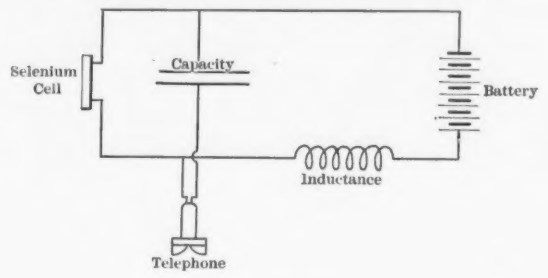


FIG. 3.—RECEIVING DEVICE.

nomenon, which is the electrical analogy of an organ pipe in action, continuous oscillation being obtained by this means; this experiment is therefore of fundamental importance for the generation of undamped electrical oscillations. He then deals with the "speaking light," i.e., the phenomenon in which the microphone currents cause corresponding oscillations of the light intensity. This gives a method of wireless telephony, on the same principle which has been used years ago for this purpose by Graham Bell. The transmitter contains the arc and a carefully cut parabolic reflector, which sends the "speaking light" into the distance; for this purpose the arc should be as small as possible; he uses an arc between a positive carbon of 5 mm, and a negative carbon of 3 mm diameter with a current of 2 to 3 amp. The receiving device, the principal part of which is a selenium cell, is shown in Fig. 3. He has succeeded in transmitting speech in this way over a distance of 2.5 km; the sounds are very clear; he thinks he can transmit speech to a distance of 4 km in this way.—*Phys. Zeit.*, April 1.

MISCELLANEOUS.

REFERENCES.

Electrometallurgy of Iron and Steel.—Three articles on the recent development in the electrometallurgy of iron and steel: the first by Ruthenberg, on the magnetic concentration of low-grade ores in the electric furnaces; the second on the Conley electric steel smelting process for the production of steel direct from the ore; the third on the Harmet process for the production of steel direct from the ore.—*The Elec.-Chem. and Met.*, March.

Blast Firing.—HEISE.—An article on the connections used in the electric firing of blasts.—*Glueckauf*, April 12.

Acheson.—A sketch, written by Fitzgerald, on the life and work of Edward G. Acheson, with portrait.—*Cassier's Mag.*, May.

New Books.

CONDUIT WIRING AND ERECTION. With special reference to the Simplex system of steel conduits. By L. M. Waterhouse. London: S. Rentell & Co. 80 pages, illustrated.

A small book of pocket size, describing in detail with many illustrations and some tables of data, the particular system of iron pipes for interior wiring mentioned in the sub-title. It is a fairly good description of the methods of installing this system of pipes and contains illustrations of the fittings made by the company which is introducing it. It cannot be considered as more than an advertisement of the system and a description of how to install it, especially as attention is called to the fact that the parts are mostly covered by patents controlled by the company, whose name appears several times.

The system consists of enamelled or galvanized steel tubes and malleable cast-iron fittings and accessories. It is claimed as a fact that at the present time a very large and decidedly increasing proportion of the buildings in Great Britain are now being installed with this system. This, if true, is a good reason for publishing a descriptive booklet of this kind. At the end there are reprints of two short articles from the *Electrical Review*, of London, on this system. The title might well have been made less desceptive if it had been limited, like the book itself, to that particular system.

POWER AND POWER TRANSMISSION. By E. W. Kerr. New York: John Wiley & Sons. 356 pages, 264 illustrations. Price, $2.00.

The subject matter of this book is drawn chiefly from the author's lectures to his classes in the principles of engineering. His purpose has apparently been to present the leading principles of engineering in such manner as shall safely guide the student in the introductory part of his work, and properly introduce him to the more advanced treatment of the subject. The book is divided into three main divisions, as follows: (1) Machinery and Mechanics. (2) Steam Power. (3) Pumps, Gas Engines, Water Power, Compressed Air, etc. Covering in this way the general field of mechanical engineering, one of the most important tasks for the author is the selection of the topics for treatment and the length of treatment to be accorded to any one.

In this respect the author seems in the main to have shown good judgment, and his style of treatment is usually plain, and his statements are accurate. Occasionally, however, the demands of brevity or the desire for too great concentration have led to inaccurate statements, as on page 184, where it is stated that steam expands according to Mariotte's law, the resulting curve being a hyperbola.

Problems are introduced freely, which will add to the value of the book for the student's use. It may be here suggested that the answers to these problems would greatly enhance their value for the student who is working by himself. The book is well illustrated, and the printing and binding are in the well-known standard text-book style of the publishers.

THE ELECTRICIAN WIREMAN'S POCKET BOOK. Edited by F. Charles Raphael. London: The Electrician Printing and Publishing Company, Ltd. 330 + xiii. pages; 174 illustrations. Price, 5 shillings.

This little book, which measures 3 x 8 ins. on the page, contains a quantity and diversity of data that the title and size do not lead one to expect. The section devoted to house wiring contains the usual tables of sizes, weights and resistances of wires and cables, together with two tables showing the relations between load in lamps, current density and drop per yard (why not foot?) for standard sizes; currents allowed by the various English insurance boards, and elementary diagrams of connections. In addition to these, there are elaborate and illustrated instructions for splicing single and stranded wires, and vulcanizing joints in rubber insulation; tables of fusing points for various wires, sizes of interior conduit and mouldings, and currents required by incandescent lamps of 20 to 230 volts, 2½ to 4 watts per candle and 5 to 50 candle-power in size; abstracts of the wiring rules of the Institution of Electrical Engineers, Phœnix, Liverpool & London & Globe, and Royal Insurance Companies, and Board of Trade motor rules; directions for testing house wiring; illustrated descriptions of the concentric wiring systems, the insulating conduit, sheathed twin conductor, and Simplex conduit systems, and finally, instructions for reading, testing and fixing meters. And this is only one section. There are four others, namely, Underground Lines, Overhead Lines, Electrical Bell and Interior Telephone Wiring, and Miscellaneous. The section on underground lines includes a sub-section on distributing systems which, excepting a page or two on polyphase systems, might have been omitted without injury to the book or loss to its readers, as the diagrams are of the most elementary text-book variety and the explanation still more primer-like. Next comes a discussion of underground conduits which is excellent, and is followed by a first-rate chapter on cable testing, amply illustrated by diagrams.

The overhead line section contains many tables of properties of iron and copper wires which are extremely useful and are not commonly found in wiring books. The succeeding section on bell and telephone wiring is also unusual and commendable, except that the diagrams of bell wiring are restricted to the simplest and most obvious plans with which every wireman's helper becomes familiar after

a few months of experience. The miscellaneous section is devoted to the Johnson & Phillips and Jandus arc lamps, lightning conductors, primary batteries and accumulators, and is of about one-fiftieth the length necessary to do even scanty justice to the subjects. The primary battery discussion gives the elements and ordinary voltages of the various cells, and the government specifications for the standard Clark cell, winding up with a blaring advertisement of a book on primary batteries. At the end is the inevitable array of tables of weights, measures, conversion factors, etc., for which the average wireman has about as much use as a cat has for a watch-pocket.

Most of the contents of the book are valuable, and while much semi-didactic material might profitably have been displaced by practical matter, the book will undoubtedly be of great use to British wiremen. There are remarkably few typographical errors, and the print is clear and legible.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass, June 18-21, 1902.

American Street Railway Association. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

Association of Railway Telegraph Superintendents. Next meeting, Chicago, June 18, 1902.

Association of Edison Illuminating Companies. Next meeting, September, 1902.

Canadian Electrical Association. Next meeting, Quebec, June 11, 12 and 13, 1902.

Engine Builders' Association of the United States. Next meeting, Pittsburg, Pa., May 22 and 23, 1902.

Independent Telephone Association of Wisconsin. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

International Association of Municipal Electricians. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

National Electric Light Association. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

Pennsylvania State Street Railway Association. Next meeting, October, 1902.

New York State Street Railway Association. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

Ohio Street Railway Association. Next meeting, June, 1902.

Old-Time Telegraphers' Association and United States Military Telegraph Corps. Next meeting, Salt Lake City, Utah, September, 1902.

An Electric Launch for Hospital Service.

An interesting electric launch, for hospital service, has just been turned out from the shipbuilding yards of the Electric Launch Company, at Bayonne, N. J. It is herewith illustrated in Figs. 1, 2, 3 and 4. The launch has a length over-all of 38 ft.; beam, 9 ft.; draught, 24 in. It is equipped with one ship electric motor, and with storage battery capacity enabling it to cover a distance of 60 miles on one charge. The highest speed made by the launch is 10 miles,

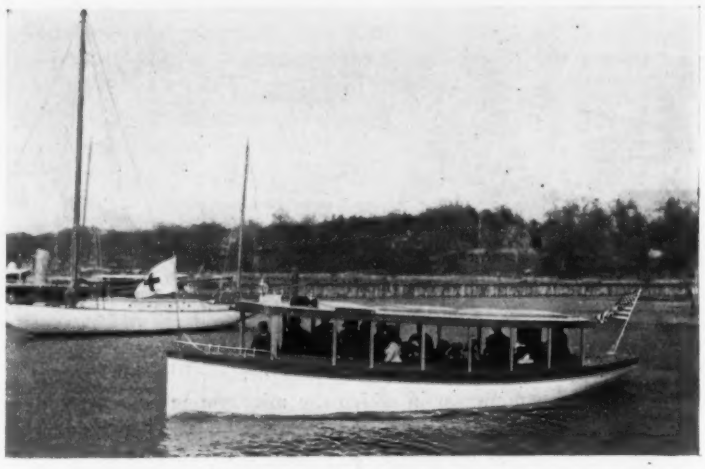
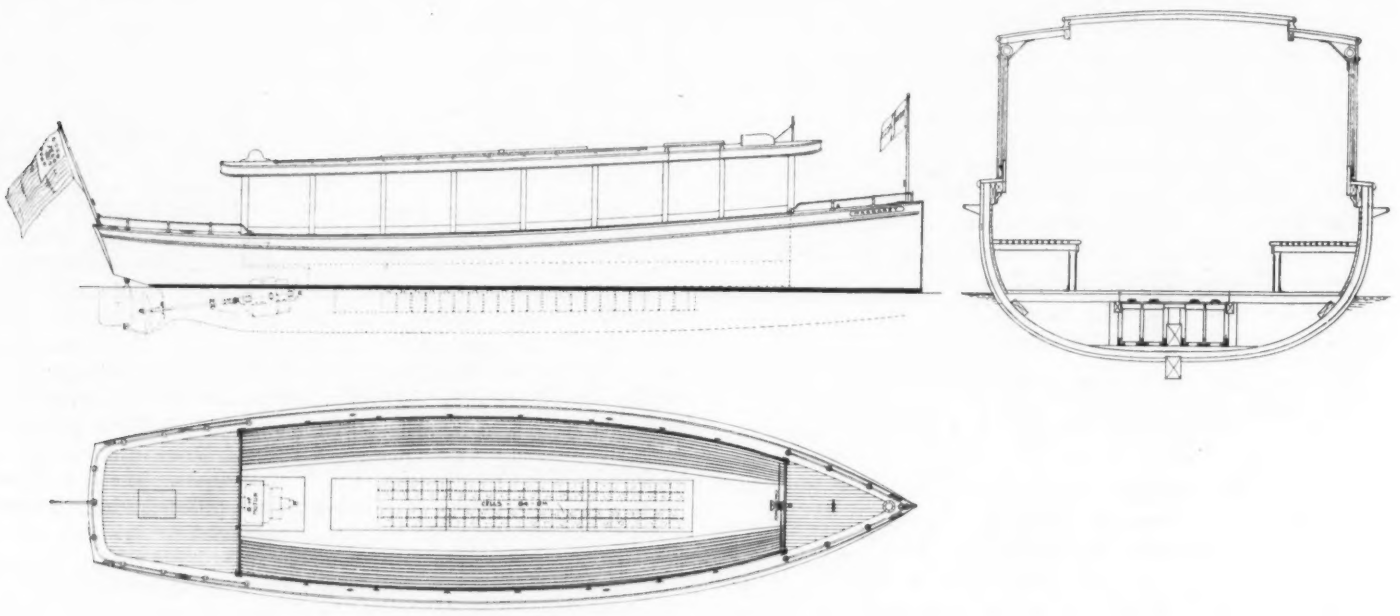


FIG. 1.—ELECTRIC AMBULANCE LAUNCH.

but speed is not one of the essential features, comfort and convenience being more desirable qualities. As usual, the batteries are placed with the motor below the flooring, not only being out of the way but increasing the stability and seaworthiness of the craft.

The launch is designed especially for transferring sick children between the floating hospitals of the St. John's Guild and the Seaside Hospital, at New Dorp, Staten Island, the floating hospital barges anchoring about a mile off shore on account of shoal water.



FIGS. 2, 3 AND 4.—SIDE ELEVATION, PLAN AND CROSS-SECTION OF AMBULANCE LAUNCH.

The boat has seating capacity for 40 adults or 60 children. It is the first electric ambulance launch ever built. Power for refilling the batteries when exhausted is obtained from the electric lighting plant of the Seaside Hospital, one man being all that is necessary to operate, charge and care for the launch.

The boat is finished in white enamel and has three entrance hatches

and a wide stretcher hatch, making an opening in the roof so that a full-size stretcher can be lowered from the hospital barge directly into the launch without disturbing the occupant. The boat is constructed strongly of oak and cedar. The seating cockpit of the launch is protected by a standing roof with pantasote roller curtains of the street car type. The curtains can be quickly lowered to protect occupants of the launch from sun and wind.

The launch was launched with full power equipment and under way under its own power immediately after touching the water. It was christened "Margaret," after the pretty Japanese custom, by Mrs. Isaac N. Seligman, being named after her daughter. The name was put on the boat when it arrived at the float to take the guests for a trip on Newark Bay. This launch is a gift to the St. John's Guild by Mr. Seligman.

Adjustable Wattmeter Shunt Coil.

Recent improvements in the Thomson recording wattmeter include the addition of the adjustable shunt field coil. This device provides for the close adjustment of friction-compensation and also offsets at the critical period any increase in friction resulting from dirt, etc. In earlier meter practice it was regarded an essential to good meter operation to clean the commutator of the Thomson wattmeter, and in other respects to restore the meter to its initial condition periodically, provided it was desired to secure the highest degree of accuracy

FIG. I.—DETAILS OF SHUNT.

in operation. Recent investigations have established the fact that the friction effect becomes practically constant after a comparatively brief period of use. Beyond this point friction increases but little, and, if instead of cleaning the commutator and restoring it to its initial condition, compensation is made for the increased friction, the meter will, except under unusual conditions, remain in a permanent condition and retain its light load accuracy.

The adjustable shunt field coil is designed to provide for this

FIG. 2.—DETAILS OF SHUNT.

compensation. With this device attached, the light load accuracy may be adjusted through a range of 10 to 20 per cent. without affecting the meter's general calibration. Thus the meter, which after a period of use may run from 5 to 10 per cent. slow at light load, may be adjusted to normal accuracy in a few minutes by moving in the adjustable shunt field coil. This adjustment can be made without moving the meter and without detaching it from the service.

All Thomson wattmeters, up to and including 1,200 amperes, are now provided with an adjustable shunt field coil, and the meter with this device attached is shown in Fig. 3. The details of the shunt

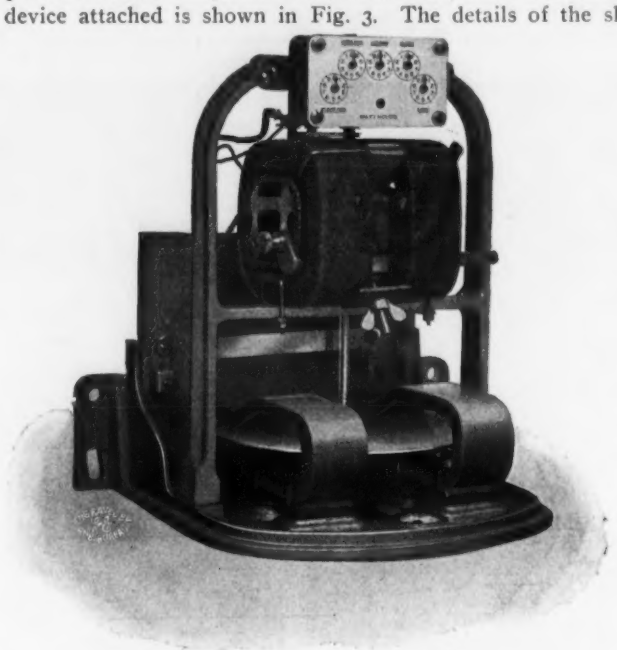


FIG. 3.—WATTMETER WITH SHUNT COIL.

device are shown in Figs. 1 and 2. This device may be attached to meters not originally provided with it.

Gold Dredging with Electric Motors.

Dredges operated by electric motors are doing much to reclaim the enormous wealth of gold lost by the wasteful methods of early placer mining. The Bucyrus Gold Dredging Company has recently purchased from the Westinghouse Electric and Manufacturing Company, of Pittsburg, a large amount of electrical machinery for the operation of its dredges in California. The chief point of activity in that State, at the present time, is on the Feather River, at Oroville. In early mining days in California, the Feather River was the scene of great activity in placer mining, many million dollars' worth of gold being taken out of Feather River Canyon. A great deal of this, owing to primitive methods of handling, was not saved, but was deposited with the "slickens" on the flats at the mouth of the canyon, below Oroville. An area of about 10,000 acres is now being partially worked over by gold dredges. Hydraulic mining having been prohibited, and the bed-rock being found at a great depth, the only feasible method of lifting this gold-bearing gravel from the bed of the river or old channels is by the dredging process of mining. The profits of operation have frequently been $1,000 per dredge daily.

Each dredger costs from $40,000 to $75,000, depending on its

FIG. I.—ELECTRICALLY-OPERATED GOLD DREDGE.

capacity. The operation of the dredge is accomplished entirely by electric motors, the current for which is obtained from long-distance transmission companies, operating in this neighborhood. Transformers are usually placed upon the bank to lower the voltage of long-distance lines, and flexible cables run from the bank to the top of the dredge, and from there to the various motors. There are usually installed motors of an aggregate capacity of 75-hp to 200-hp on each dredge. One of the accompanying photographs shows a

variable-speed Westinghouse induction motor driving a countershaft, from which the main dredging buckets are operated. These

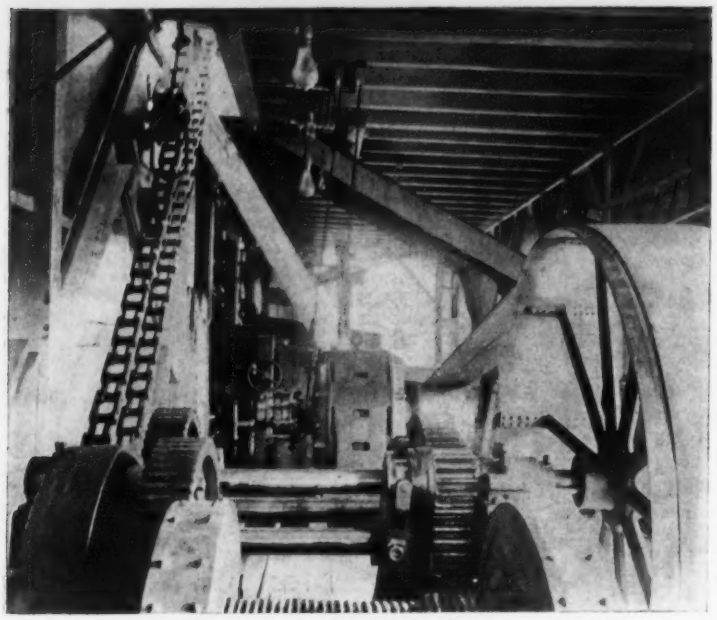
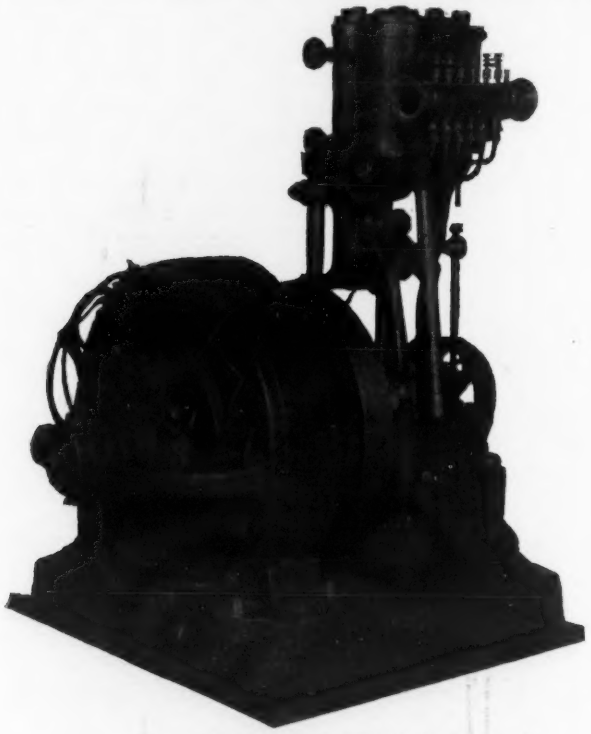


FIG. 2.—INDUCTION MOTOR DRIVING COUNTERSHAFT.

buckets raise the material from the bed of the river to the shaking screens on the top of the dredge.

Small Direct-connected Generators.

The New England Motor Company, of Lowell, Mass., is placing upon the market a line of small direct-connected generators, designed with a view of obtaining the highest possible weight efficiency. These machines are built of the six and eight-pole type,



DIRECT-CONNECTED GENERATOR.

and, as the cut herewith shows, are of a pleasing and symmetrical appearance. The commutators have very large surface, so as to be able to hold the current density at a low point, usually not exceeding 20 amperes per square inch of brush surface contact. The armatures are very finely laminated, No. 28 gauge deoxydized and annealed armature steel being used, which gives about sixty laminations to the inch. The armature coils are form wound and separately hand taped. The armature slots are insulated with micanite before the coils are placed therein. The field coils are wound on forms, very carefully taped, and painted with water-proof paint. As showing how light these sets may be built, attention is called to the 3-kw, direct-connected set, which weighs, complete with a Forbes engine, 550 lbs. Such sets would seem to have a special field in yachts and elsewhere, as well as being generally applicable.

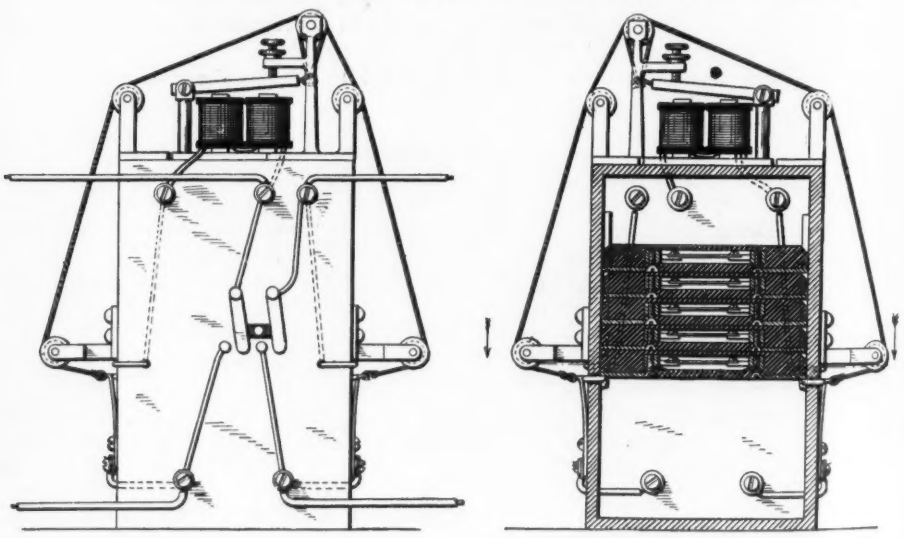
Telephone Manfacturers Association o the United States.

As previously announced in these columns, a meeting of independent telephone manufacturers of Chicago was held at the Oxford Hotel soon after the Interstate Independent Telephone Convention, for the purpose of forming an organization. At that time, a committee was appointed to draw up rules, and this committee reported to a meeting, held at the same place, May 5, at which time an organization was effected. The officers elected were: Alfred Stromberg, president; Kempster B. Miller, vice-president; James E. Keelyn, secretary, and C. F. Messinger, treasurer. The association membership consists of companies and not of individuals. It will be known as the Telephone Manufacturers Association of the United States.

The board of directors is: Frank G. Jones, American Electric Fuse Company, Chicago; H. E. Procunier, Moon Manufacturing Company, Arthur Stein, Eureka Electric Company, Chicago; L. G. Bowman, Western Telephone Construction Company, Chicago; C. W. Farr, Farr Telephone and Construction Supply Company, Chicago; H. H. Hipwell, Hipwell Manufacturing Company, Allegheny, Pa.; C. E. North, North Electric Company, Cleveland, O. Messrs. Jones, Procunier, Bowman and Hipwell constitute the executive committee, with Mr. Keelyn as its secretary. Concerns must have been engaged in the telephone business for more than a year to be eligible for membership, and must be manufacturers. There is no admission fee, but annual dues of $5 per member are to be paid in advance. A regular meeting is provided for once a month.

Magazine Fuse.

The device shown in the illustration is an improved fuse-box, having for its object to provide a means for automatically inserting fuses in an electric circuit. There are a plurality of fuse holders arranged one above another within an enclosing case; each holder having a fuse, and the bottom holder being in circuit. When the fuse in this holder "blows," the holder drops by the force of



FIGS. 1 AND 2.—MAGAZINE FUSE.

gravity, allowing the next holder with its fuse to fall into place, thereby closing the circuit again. As many holders as are desired may be used—the number depending upon the size of the enclosing case.

While the device will not keep a circuit closed in case of a "dead" short-circuit (for this would not be desirable), it will keep a circuit closed during a lightning discharge or temporary short-circuit. The consumer, therefore, has protection at all times, and is assured of continuous service in the majority of instances. The device is the invention of Jas. T. Watson, of Scranton, Pa.

Wattmeter for Alternating and Direct Currents:

The Diamond Meter Company, of Peoria, Ill., is placing on the market new Scheeffer meter that may be used on direct as well as alternating currents. Although there exist objections to meters with commutators, still they are with reasonable care capable of high accuracy, and possess the advantage that they may be used indifferently on direct as well as alternating currents, and are unaffected by alternating or lag current. Mr. Scheeffer's object in the improvement in the form shown is to eliminate or reduce to a minimum the faults to which heretofore objections were made in connection with motor meters with commutators. The meter shown in the accompanying cuts is made somewhat different from what has been customary in this class of meters. The improvements are as follows:

1. The elimination of dust and dirt by using a cast case, a sheet metal case not being considered rigid enough to admit of a sure and tight fit. The case is made of cast aluminum, and fits down tight over a rubber gasket, being forced to an air-tight fit at the joints with screws. All other parts of the meter are also air-tight.

2. The armature consists of a mica disk on which are mounted three machine-wound coils; these coils are of fine wire and are very light, and being machine made admit of using a very fine wire with ease and safety. The commutator is one-eighth inch diameter,

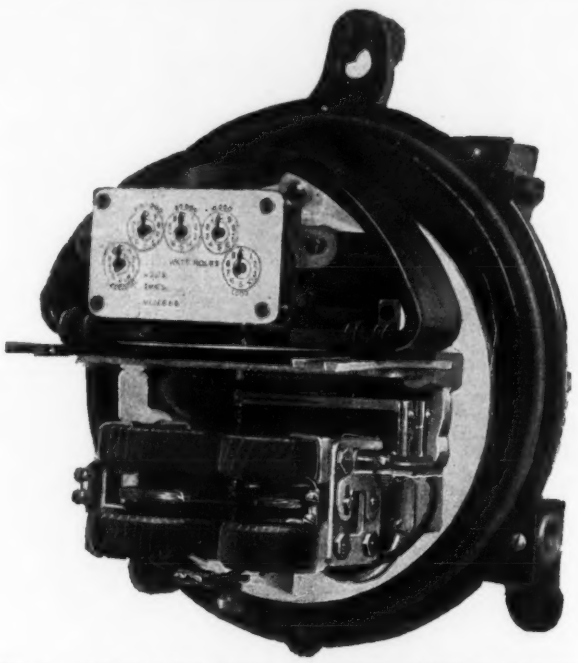


FIG. I.—METER MECHANISM, SHOWING DAMPING MAGNET.

and has three sections; and as it is only one-eighth inch in diameter, the friction is very slight from the brushes, which press very lightly. By using the form of damping magnet shown ,a large and very powerful magnet is the result, which very high damping results from the use of a very light aluminum disk. The whole armature, including shaft, commutator and damping disk, is very light, not being heavier than those used in induction meters, and thus giving a highly sensitive armature. The armature can be taken out at any time if necessary to repair or inspect by simple taking off the movement and damping magnet, and it is as readily replaced. The brushes are two straight, highly elastic strips of phosphor bronze, which can be slipped aside very quickly to inspect or clean and repolish. The commutator and brushes are in plain sight for ready inspection.

The damping magnet is slipped on guide pieces so that they can be readily taken out or replaced at any time without disturbing the meter in any way. In calibrating the meter it is not necessary to disturb or move the damping magnet in any way, simply using the brass handle on the left side of the meter which moves a piece of iron, whereby the speed of the meter at full load is readily adjusted.

The resistance is placed in the back of meter, and consists of a disk of wire wound, non-inductively, placed on a plate which is screwed on the back. If the resistance is to be inspected, repaired or replaced, all that is necessary is to unscrew the back plate and take it out, as shown in the cut. These resistances are made in disks for 100-volt unit each. Thus, for 200-volts two disks are used in the same meter.

With the disk form of armature, shown with three coils, Mr. Scheeffer claims about double the efficiency of the regular drum armature. At 100 volts the armature current in the shunt corresponds only to 2½ watts. The drop through the series coil is very low.

The meter is direct-reading, no constant being employed. It is

FIG. 2.—ARMATURE.

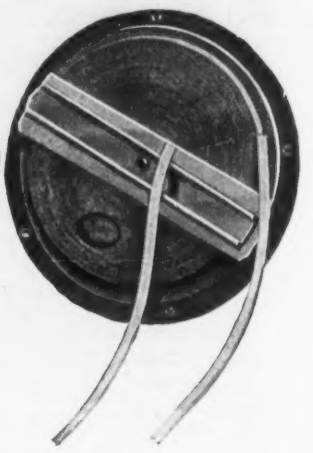


FIG. 3.—RESISTANCE COIL.

provided with the Scheeffer improved ball-bearing, which has proven in practice a very efficient bearing and much superior to a solid point; it is easily replaced with ball or jewel, and the wear is negligible because of the superior wearing qualities of a ball to those of a solid point.

The Marburg Electric Pump.

The accompanying half-tones, Figs. 1 and 2, illustrate two types of the Marburg direct-connected electric pump that has recently been placed on the market. The pump is very compact, occupying but little floor space. The discharge from this pump is continuous, which prevents "water hammer" and undue noise in buildings through the operation of the pumps.

In ordinary rotary pumps the friction has been large, and undue

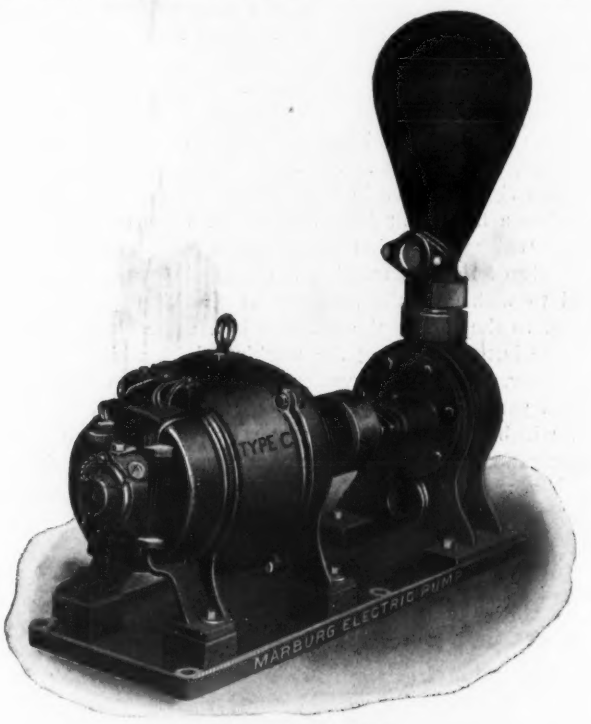


FIG. I.—ELECTRIC PUMP.

wear has been the result. To overcome the friction in the Marburg pump, the internal pressures which are caused in all pumps, due to water pressures, have been perfectly balanced by a very simple device, thus making the pump work with normal friction only, both

at high and low pressure. The wear, depending on the friction, has in this way been almost entirely eliminated, and a very thorough test of the pump shows little or no wear.

The pump is made in a number of sizes, the various capacities

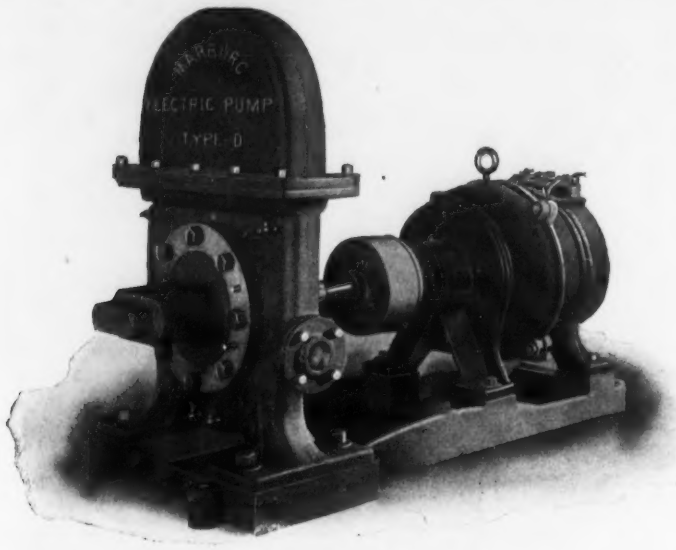


FIG. 2.—ELECTRIC PUMP.

being 300 to 1,500 gallons per hour, 60 feet high, and 3,500 gallons per hour, 125 feet high. The type shown will pump 3,000 gallons 175 feet high. These pumps are manufactured by the E. W. Bliss Company, of Brooklyn, N. Y.

Water Wheel Governor.

We illustrate herewith a recent development in governors for water-wheels driving electrical generators, from which it will be seen that the general design is quite a departure from previous practice. Fig. 1 represents a section of the governor, and Fig. 2 is an external view, showing its application to a 2,000-hp water-wheel in the plant of the Virginia Electric Railway & Development Company, at Richmond, Va.

The governor is of the hydraulic type, the gate of the water-wheel being controlled directly by a piston mounted upon a shaft, somewhat after the principle of a rotary engine, the shaft being connected to the gate shaft of the water-wheel. The piston is rectangular, and by means of substantial cast-iron packing strips, tongued and grooved into each other at the joints, a perfectly fluid-tight joint is made against the walls of the cylinder. It makes but .87 of a revolution, this being sufficient to move the gate through its full range, the limits at the ends of the stroke being formed by a partition rigidly bolted in place within the cylinder; this partition also makes a fluid-tight joint against the walls of the cylinder and upon the enlarged portion of the shaft which carries the piston. The whole of the construction is extremely massive, and well calculated to withstand the strains of controlling the heaviest gates.

Bolted to the top of the cylinder is a valve chamber and piston valve, the latter admitting the working fluid, which may be either oil or water, to ports communicating with one or the other sides of the fixed partition. This valve is controlled by a centrifugal governor, which runs loosely upon an extension of the main shaft, communication between the governor and the valve being made through a rocking lever. The governor, however, does not move the valve directly, as the friction of the latter, when made of sufficient size to produce quick gate movements, would interfere with the delicacy of the governor. Instead, an arrangement shown in the sectional view is adopted, by which it will be seen that a small inner valve, controlled by the governor, admits fluid through ports formed in the main valve to piston extensions attached thereto, the latter working in an extension of the valve liner. As the lap of the small valve is barely 1-64 of an inch, any movement which it makes causes a corresponding movement in the main valve. This arrangement enables a most delicate governor to be employed, which is in no way affected by any stiffness which may develop in the main valve.

A noteworthy feature in this governor is the method adopted for preventing racing and overrunning of the gate, one of the prime difficulties encountered in regulating water-wheels. This difficulty is caused by the fact that the water-wheel does not immediately respond to an increase or decrease in the gateage, so that after a momentary change of speed has occurred, due to a change of load, the governor would, normally, continue to move the gate until the speed of the water wheel, and, therefore, the speed of the centrifugal governor, were restored to normal; and by the time this occurred the gate would have been moved too far, thus causing the speed to vary as much, if not more, in the reverse direction. In checking this further variation, the governor would again move the gate too far for the same reason, and thus a constant oscillation of the gate, of increasing or decreasing amplitude, according to the particular conditions of the plant, would result, causing violent fluctuations in speed.

The obvious and most direct way to counteract this lag is to restore the speed of the centrifugal governor to normal, somewhat in advance of the water wheel itself, and this is the method adopted in the Sturgess governor. It is effected by slightly varying the diameter of the governor pulley, which is ingeniously designed for this purpose. The pulley consists of two cones having eight radial grooves in which set as many segments, the segments forming the face of the pulley.

FIG. 1.—WATER-WHEEL GOVERNOR.

The outer cone is keyed rigidly to the quill of the governor pulley, and the inner cone has a slight endwise movement upon a featherway. The tension of the belt and two coiled springs concealed within the segments hold the latter in place in their grooves upon the cones. When running, the pulley is true and appears as though it were a solid piece of cast-iron with the ability to expand and contract. The sliding cone is connected through levers, and a dash-pot of special construction, which slides back and forth upon a slide formed in the valve chamber, to a cam upon the gate shaft, so that any movement of the latter, when opening or closing the gate, causes a slight movement in the cone, and, therefore, a slight variation in the diameter of the governor pulley. The variation, however, is only of sufficient duration to allow the water wheel to restore to its normal speed, for as it does so the dash-pot, which has a constant tendency to return to its central position, restores the cone to its original position, giving the pulley its normal diameter.

The restoration of the dash-pot to its central position is effected by the admission of fluid to one side or the other of its piston; this fluid is taken from the main source of supply by a pair of coiled copper tubes connected to the inlet and outlet on the valve chamber. The dash-pot has a valve chamber and slide valve on its upper face, the slide valve being connected by links to an upward extension of

the levers controlling the cone pulley. Any deflection of these levers from their central position causes the slide valve to uncover one or the other of the ports in the dash-pot, so that the dash-pot will move in a direction which would cause the ports to become again covered.

The operation of the governor will be clear from the above

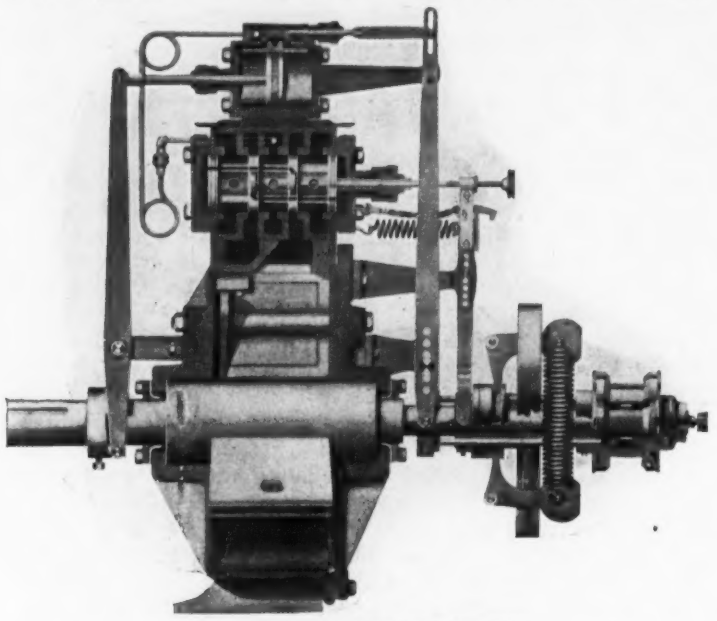


FIG. B.—SECTION VIEW OF GOVERNOR.

description of the function of the various parts. All the parts with the exception of the main piston and the piston of the dash-pot ride normally in their central positions. Briefly stated, the controlling effect is as follows:

The variations in load tend to produce constant variation in speed, and the centrifugal governor therefore tends to as frequently vary the position of the main valve and cause the gate to be opened or closed. These movements of the gate produce, through the agency of the cam, a constant tendency to change the position of the dash-pot, these changes being again neutralized by the tendency of the dash-pot to return to its normal position after the desired check has been produced upon the centrifugal governor. Stated in another way, the speed of the centrifugal governor is determined not only by the speed of the wheel but by the influence of the secondary controller comprised in the dash-pot and its connecting levers.

This governor, which is manufactured by the Sturgess Governor Engineering Company, West Troy, N. Y., is said to work very freely and without shock or apparent effort.

Spinning Jenny for Line Wires.

The accompanying illustration shows a spinning jenny, made by James S. Barron & Co., New York, for use by telephone companies. It is made in two sizes, namely, 18 inches and 24 inches long, both lengths having an inside diameter of two inches, and is claimed to be the most practical tool yet devised for elevating and binding cables to supporting wires. The operation is extremely simple. The jenny is in two parts, which enables it to be placed in position encircling the cable and supporting wire at any point on the line. The two sides are provided with dowel lockings, and are copper lined

SPINNING JENNY.

to prevent any injury to the cable. The marline for binding purposes is wound around the jenny, in one or more layers as required; the outer end being fastened at the place of starting. The rear end of the jenny is beveled so as to allow the marline to play off smoothly. The cable to be bound is elevated from a snatch block hung on the supporting wire just ahead of the jenny, and the binding is done by the spinning off of the marline as the jenny is hauled along by means of the rope fastened to the iron arm.

Crossings and Section Insulator.

The H. W. Johns-Manville Company, New York, is bringing out two types of overhead fittings to meet distinct conditions of service—an uninsulated or metallic crossing, and an insulated crossing, for use where it is desired to electrically separate the intersecting trolley wire and yet maintain perfect mechanical continuity of the trolley wires, so as to give an even under-run for the trolley wheel.

Fig. 1 shows the uninsulated or metallic crossing, a description of which will bring out the general features embodied in both types. It will be noted the crossing wires first pass through a hinged clamp after passing under a curved flange, and then pass over the top of the centrally hinged arms, forming the two parts of the crossings.

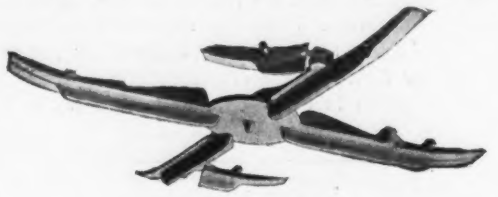


FIG. I.—UNINSULATED CROSSING.

For the purpose of permanently fixing the wire, its path from one end to the other of the arms is well grooved. The novelty of the hinged clamps at the ends of the arms, for holding the trolley wire and firmly fixing the crossing, is to be particularly noted. This is so arranged that it will take trolley wire from 1/0 to 4/0 inclusive, and the manner in which the trolley wire enters the clamp is such that the trolley wheel as it strikes the curved flange is pressed downwardly from the wire and is caused to run on its flanged edges across the arm to the other end, where it is allowed to gradually rise and again bring the grooved portion of the wheel in contact with the wire in a very gradual fashion. The absence of solder in using these crossings will be appreciated, since in previous devices it has in almost all cases been necessary to solder the crossing to the trolley wire.

The insulated crossing is almost equally simple, but instead of the

FIG. 2.—INSULATED CROSSING.

two arms coming into metallic contact, one of the arms is fitted with an insulated cylindrical cup, so arranged that the wire connected with that particular arm passes over the top of the arm, but is kept from contact with the metallic portion of the other arm by the arrangement of the insulating cylinder. The two arms are easily separated from one another by the manipulation of two screws, upon the removal of which and the swinging of the guides which they hold in place the two arms are at once separable. The lower arm can then be connected to one trolley wire after removing the cylindrical cup therefrom and after replacing this cup and putting the upper arm in position so that it is properly pivoted thereon, and readjusting the two guides on the lower side of the upper arm, the two parts of the crossings are again in their coacting relationship. The other wire is then passed over the other arm and the entire device is ready

FIG. 3.—SECTION INSULATOR.

for use. An important feature of this insulated crossing is the use of a metallic running surface for the trolley wheel, located at the central portion of the crossing, but which is insulated from both arms. This metallic running surface eliminates wear at this point, which in the past has been entirely of insulation, and thus wear and tear at this point is greatly decreased and a more even operation is obtained.

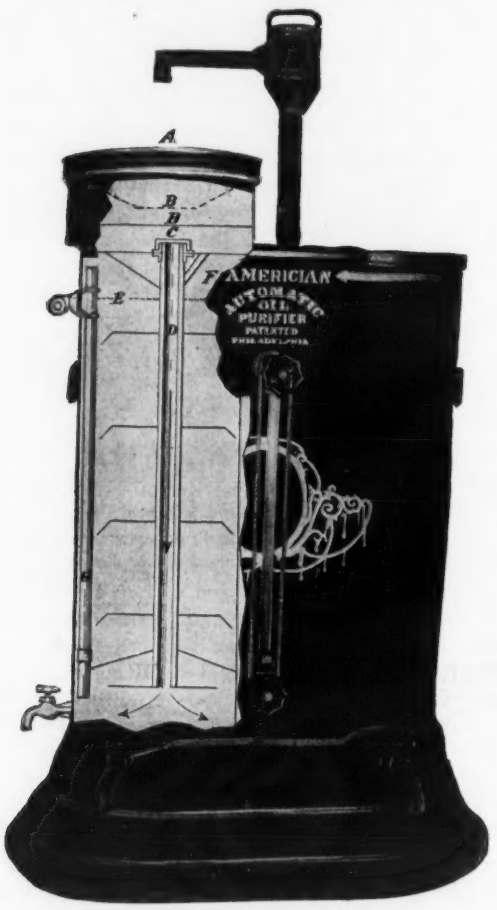
The "New" Philadelphia section insulator has also been brought

out, which embodies the same desirable features as regards the even under run, facility of attachment and universal use over a range of trolley wire sizes from 1/0 to 4/0 inclusive. The trolley wire passes into clamps at the end of this section insulator, these ends being generally similar in their arrangement to the ends of the crossing arms. Each of the metallic ends is also provided with an arrangement for feeding in or "jumping" across. The central or insulating portion of this section insulator is made up of ¾-in. thick, specially treated fibre, arranged to give a very long break between the two sections. Although these devices have only been on the market for a very short time, they have already found very extensive use, and proven highly satisfactory.

All of the castings used in the metallic crossings, the insulated crossing and section insulator are malleable iron, galvanized, and all screws and rivets are brass. In case of two wires crossing each other, one of the wires being 1/0 or 2/0 and the other 3/0 or 4/0, either round, grooved or figure 8, the crossings above described will accommodate these wires in every case without extra cost or change of parts.

Oil Filter.

An oil filter is shown in the accompanying illustration in which the filtering process is accomplished without the use of any filtering material whatever other than water. The perforated pan at the top of the filtering chamber is filled as full of water as the overflow will allow. The waste oil is poured or pumped in at *A* and passes through the strainer in the pans *BB*, which remove the larger impurities from the oil before it reaches the chamber *C*. It then flows through a perforated cap on the top of the tube *D* into the chamber at the bottom, and up through the perforated horizontally-disposed pans or strainers to the surface of water at *E*. The purified oil is conveyed to the storage tank through the overflow *F*, and the water flows out of the vertical overflow pipe *G* to the sewer.



OIL FILTER.

This filter is so constructed that the strainers may be removed and the purifying and filtering chamber inspected or cleansed without interfering with any other part of the apparatus. It is made of heavy galvanized iron, the filtering and storage compartments being separate. In order to facilitate the filtering process, the water used may be heated by means of a steam pipe.

This filter is manufactured by the American Oil Filter Company, Philadelphia, Pa.

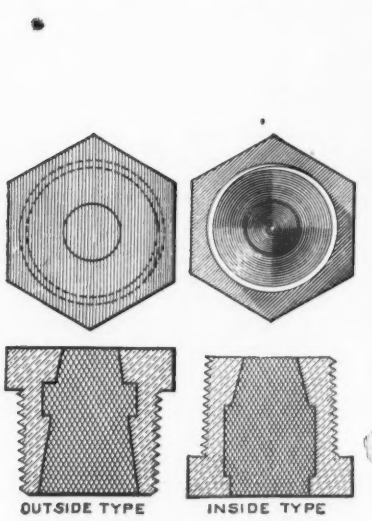
Boiler Fusible Plugs.

Fusible plugs have been used in boilers for a great many years, and the Government, recognizing the important function of this boiler accessory, now requires that all plugs used on boilers of steam vessels should be made of bronze and have no other filling but pure Banca tin. Many plugs have been offered on the market, which are filled with fusible alloys composed of other metals, which, although melting at very near the same point as Banca tin, were not absolutely reliable. Since the disaster at Philadelphia, last fall, the United States Steamboat Inspection Service of the Treasury Department has taken cognizance of the fact that inferior plugs were offered upon the market, and issued a circular requiring that all fusible plugs should be filled with pure Banca tin and stamped with the manufacturer's name, and that an affidavit setting forth this fact should be filed with the inspector having charge of the boiler inspection at whatever point the plugs were used.

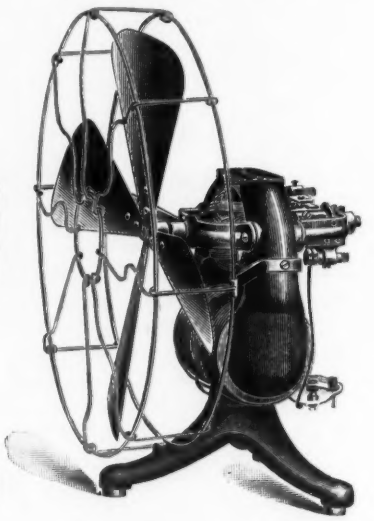
The Lunkenheimer Company has manufactured fusible plugs for a number of years, all of which comply with these specifications, and, having made affidavit before the United States Steamboat Inspection Service to the effect that its plugs comply with these requirements, the same are accepted by all inspectors throughout the United States. Below are illustrated two forms of plugs; namely, the outside and inside patterns, to be screwed in either from the inside of the boiler or from the outside through the fire-box or shell. These plugs are manufactured by the Lunkenheimer Company, of Cincinnati, Ohio, who will be pleased to give further particulars upon application.

Battery Motor.

The Knapp Electric and Novelty Company, 507 West Fifty-first Street, New York, is placing on the market a new design of battery motor. As will be noted from the accompanying illustration, the motor is handsome in appearance, and the makers claim that it embodies a number of points of excellence not heretofore found in battery motors. The electrical and magnetic design is such as to give an extremely high efficiency, which is a point of the utmost importance in connection with motors taking their current from primary or storage batteries. The armature is of the slotted, drum type, built up of laminated iron, the armature wires being connected to a six-part commutator. The brushes are interchangeable with the turn of a screw, and have a long spring adjustable device, giving an easy and positive contact. The bearings are self-aligning, and the binding posts and switches are mounted on a fibre base. The motor is mounted on rubber feet, and is made with two windings—for 2 to 4 volts, and 8 to 10 volts.



FUSIBLE PLUGS.



BATTERY MOTOR.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was inactive, closing at 4 @ 5 per cent. for six months, while shorter dates brought 5½ @6 per cent. The stock market was quieter, being somewhat affected by the possibility of a strike among the coal miners. There was a tendency to improvement, largely on manipulation, although high money rates, coupled with further violent breaks in specialties, and the failure of three stock exchange houses, caused some temporary unsettling of the market. Industrial stocks were somewhat neglected, although the United States Steel shares received support. The referee's decision sustaining the constitutionality of the franchise tax law had little effect on the traction stocks. The trading in this group was not large, and some support was shown in Manhattan. Amalgamated Copper remained steady, and later in the week was bought by Boston interests, reports of better conditions in the copper trade being circulated. In the traction list Brooklyn Rapid Transit closed with a net loss of 1¼ points, the last quotation being 65⅞. Metropolitan Street Railway closed at 149, a net loss of 1½ points. General Electric closed at 321, after having risen to 357½ during the week, the closing price being a net loss of 2 points. Westinghouse, common, lost 4 points, closing at 216, and first preferred lost 13½ points, the closing price being 219½. Western Union made a net gain of ⅝ point, the closing price being 92, and American District Telegraph ¾ of a point, the last quotation of the week being 39¾, ex-div. American Telegraph and Cable closed at 92, a net loss of 1 point, and American Telephone and Telegraph at 181½, a net gain of ½ point. Manhattan Elevated rached 133¾, closing at 131⅞, being 11⅛ points below the closing quotation of the week previous. Following are the closing quotations of May 13:

NEW YORK.

	May 6.	May 13.		May 6.	May 13.
American Tel. & Cable.	88	92	General Carriage	3	3
American Tel. & Tel...	181½	178¼	Hudson River Tel.....	—	—
American Dist. Tel....	39½	38½	Metropolitan St. Ry...	151	147¼
Brooklyn Rapid Transit	67⅝	65⅜	N. E. Elec. Veh. Trns.	14¼	—
Commercial Cable	150	155	N. Y. E. V. T. Co.....	—	13½
Electric Boat	33	34	N. Y. & N. J. Tel..	—	—
Electric Boat pfd.....	50	48	Tel. & Tel. Co. Am....	4½	—
Electric Lead Reduc'n	—	—	Western Union Tel..	91½	91¼
Electric Vehicle	7	7	West. E. & M. Co...	219	209½
Electric Vehicle pfd ..	—	13	West. E. & M. Co. pfd..	220	209
General Electric	326	319¾			

BOSTON.

	May 6.	May 13.		May 6.	May 13.
American Tel. & Tel..	181½	178	Mexican Telephone....	2¼	2¼
Cumberland Telephone	—	—	New Eng. Telephone.	150*	149*
Edison Elec. Illum....	—	—	Westinghouse Elec....	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd	—	—
General Electric pfd...	—	—			

PHILADELPHIA.

	May 6.	May 13.		May 6.	May 13.
American Railways ...	—	—	Phila. Traction	97½	97½
Elec. Storage Battery..	91½	85	Phila. Electric	5⅝	5¼
Elec. Storage Bat'y pfd.	91½	84½	Pa. Elec. Vehicle.....	—	—
Elec. Co. of America..	7⅛	—	Pa. Elec. Vehicle pfd...	—	—

CHICAGO.

	May 6.	May 13.		May 6.	May 13.
Central Union Tel....	—	—	National Carbon pfd.	89	91*
Chicago Edison	170	172½	Northwest Elev. com..	38	37
Chicago City Ry.....	215	215	Union Traction	21	19½
Chicago Teleph. Co....	—	—	Union Traction pfd ..	56	54
National Carbon	25¼	25½			

*Asked.

ST. LAWRENCE POWER PLANT SOLD.—Guthrie, Cravath & Henderson, of New York, representing the complainants in the foreclosure action brought by the Commercial Trust Company of New York and the Morristown Trust Company against the St. Lawrence Power Company, at Massena, N. Y., the Standard Trust Company, of New York, and the United States Mortgage and Trust Company, obtained a decree in foreclosure and sale from Judge Coxe in the United States Circuit Court, at Utica, N. Y., on May 14. James DeP. Lynch was appointed as master and he will sell the power plant at Massena in about six weeks. The judgment order provides for rejection of bids under $500,000. There was no opposition to ordering the sale of the property. The foreclosure suit was brought by the first and second mortgage bondholders as the result of the company's defaulting upon its bonds. A plan has been projected for a reorganization. It is understood that the sale of the property will not affect the big power scheme, which is all right from an engineering standpoint, but needs large customers.

NEW ORLEANS TRACTION.—The New York Security and Trust Company is syndicate manager of the consolidation of the street railways of New Orleans. The new company will have $10,000,000 fifty-year 4½ per cent. sinking-fund bonds, $10,000,000 4 per cent. cumulative preferred stock, and $30,000,000 common stock. Holders of New Orleans City Railroad preferred stock can sell for 112½ cash, the common for 35; New Orleans Carrollton Light and Power preferred stock at 105, and the common stock at 95; Orleans Railroad stock at 160; New Orleans Gas Light at 125; New Orleans Lighting stock at 60 and bonds at 110. The New Orleans Railway Company bonds can be sold at 105. All the securities, however, can be exchanged on more favorable terms into the securities of the Consolidated Company. Estimating the value of the new bonds at par, the preferred at 60, and the common stock at 15, the offer of exchange is about 11 per cent. preferable to the offer in cash.

DIVIDENDS.—Trustees of street railway illuminating properties paid a distribution of $1 per share on May 13 to holders of common shares of record May 9. The Niles-Bement-Pond Company has declared the regular quarterly dividend of 1½ per cent. on preferred, payable May 20. The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 1½ per cent., payable June 2. The Tampa Electric Company, of Tampa, Fla., has declared regular semi-annual dividend of $3 per share on the capital stock, payable May 15.

BOSTON EDISON STOCK.—The stockholders of the Edison Electric Illuminating Company, of Boston, at a special meeting, on May 14, voted to increase the capital stock by 16,500 shares, and authorized the directors to sell five parcels of real-estate owned by the company, and not needed in the business. The new issue will provide $3,300,000, and it is made to capitalize expenditures this year of $1,000,000, for extensions and improvements; to provide $500,000 for machinery, and to secure funds for the building of a new 75,000-hp station in South Boston.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has just completed an order for the equipment of the Edison Portland Cement Company's new plant at Stewartsville, N. J., with its motor starters throughout. Before placing the order for the starters the Edison Portland Cement Company conducted exhaustive competitive tests upon motor starters, and then, we are informed, placed the order for the entire equipment of motor starters with the Ward Leonard Electric Company. In view of Mr. Edison's familiarity with the requirements of electrical apparatus, the obtaining of this order is quite a testimonial to the quality of the Ward Leonard starters.

ELECTRIC COMPANY OF AMERICA.—A call is being issued for a special meeting of the Electric Company of America stockholders, to be held June 4, at 11 A. M., at Camden, N. J., to approve the proposed reduction in capital from $25,000,000 to $5,000,000. After this has been done, the directors will consummate the other features of the plan by calling a net assessment of $1 per share and crediting $1.50 on the stock, making the present $7.50 paid stock full paid $10.

SAN FRANCISCO.—The United Railways Investment Company, of San Francisco, has filed a certificate increasing its capital stock from $2,500 to $25,000,000. Of the capital stock $15,000,000 is to be 5 per cent. cumulative preferred and $10,000,000 common. Provision is made that the preferred stock may be retired after three years by the payment of its par value plus a premium of 10 per cent. and dividends.

WESTERN UNION IN BALTIMORE.—The Western Union Telegraph Company has acquired a controlling interest in the American District Telegraph Company in Baltimore. It is reported that a syndicate, in which the Western Union is largely interested, is planning a consolidation of the district telegraph companies in all of the large cities, which will include the American.

NORFOLK, VA., PROPERTIES.—It is stated that the details of a big street railway combination, involving $7,500,000, have been completed, and that the holdings of the Williams syndicate on the Norfolk Railway and Light Company are to pass into the hands of Messrs. Alexander Brown & Sons and Nelson Perrin, of Baltimore.

UNITED GAS IMPROVEMENT.—Stockholders of the United Gas Improvement Company, of Philadelphia, have approved the proposition to increase capital stock from 450,000 shares to 565,000 shares, the par value being $50.

COMMERCIAL PACIFIC CABLE.—The Commercial Pacific Cable Company has filed with the Secretary of State, at Albany, N. Y., a certificate of increase of its capital stock from $3,000,000 to $12,000,000.

NEW ENGLAND TELEPHONE STOCK INCREASE.—The stockholders of the New England Telephone and Telegraph Company have voted to increase the capital stock from $20,000,000 to $30,000,000.

NEW YORK TELEPHONE COMPANY.—At the annual meeting of the New York Telephone Company, held at the company's offices, 15 Dey Street, New York, on Tuesday, May 6, 1902, the following directors were elected: Union N. Bethell, John H. Cahill, Thomas F. Clark, Robert C. Clowry, Charles F. Cutler, Joseph P. Davis, Frederick P. Fish, George J. Gould, Edward J. Hall, James Merrihew, Charles Steele, John B. Van Every and William H. Woolverton.

UNION TRACTION OF PHILADELPHIA.—Union Traction stockholders have approved the lease of the property and the issue of $1,500,000 collateral trust bonds to refund floating debt.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a more cheerful tone in distributive trade during the week, owing to improved weather conditions. The situation in manufacturing generally is characterized by activity, the only important exception being in the woolen industry, which is interfered with by strikes. The unsettled anthracite coal situation also overhangs the Eastern trade situation, but the bituminous industry reports much activity. In the iron and steel trades the current demand still pushes them to the utmost tension to keep up. The feature in iron and steel is the scarcity of supplies of pig iron, and the strength of the demand for finished products, particularly structural materials. Some scattered lots of standard rails brought $31 per ton during the week, against the nominal price of $28. The mills at Pittsburg are reported to have orders six months ahead for structural material, the sales of which for the week were very heavy. Building, and all lines dependent thereon, are active despite the increased cost of labor and of builders' hardware and the higher level of wages. Railway earnings are very good in view of the somewhat adverse conditions in grain, cattle, etc. The gross earnings so far reported for April show a gain of 11.2 per cent. over the corresponding month last year. The Pacific Coast roads return a gain of 16 per cent.; the Grangers one of 15.8 per cent., and the Southern roads one of 13.7 per cent. The Central Western roads show an increase of 8.3 per cent., while the Trunk lines contribute a gain of 8.8 per cent. Copper was a little more active, a large business being reported for early and distant shipment. Prices show a slight improvement. Lake is quoted at 12@12⅛c.; electrolytic in cakes, wire-bars and ingots, 11⅝@11¾c.; casting stock, 11½@11⅝c. The business failures of the week, as reported by Bradstreet's, numbered 179, as against 174 the week previous, and 193 the same week last year.

GUANAJUATO POWER TRANSMISSION PLANT.—Some further information is just to hand regarding the Guanajuato Power and Electric Company, which, as already stated in these columns, was recently formed with a capital of $3,000,000 for the purpose of constructing a 12,000 hp plant and to convey electric energy by means of a high-voltage transmission line 125 miles long to the cities of Guanajuato, Leon and six smaller Mexican cities. In addition to Messrs. Coffin, Adams, Curtis, Peck and Bonwright, several other prominent Americans are interested in the venture. The list comprises John S. Bartlett, of Boston; D. O. Mills, of New York; William H. Crocker, of San Francisco; General William J. Palmer, of Mexican National railroad fame; George Foster Peabody; E. H. Rollins, of Boston; Cyrus H. McCormick, of Chicago, and Thomas Hine, of Colorado Springs. John Hays Hammond, the well-known South African mining expert, is also interested. Frederick W. Baker, president of the Venture Corporation of London, represents some English capital in the enterprise. The officers of the company are: President Thomas Hine; vice-president, John Hays Hammond; vice-president and treasurer, Leonard E. Curtis, who is one of the attorneys of William P. Bonwright & Co., the Denver bankers; secretary, Irving W. Bonwright, and assistant secretary and assistant treasurer, E. R. Coffin. Mr. Hine has just returned from Mexico, where he was accompanied by P. T. Hansom, of the designing department of the General Electric Company, and Frank E. Shephard, president of the Denver Engineering Works. The city of Guanajuato is the center of one of the most important mining regions in the Republic, but operations have not been very extensive, owing to the cost attached to steam power. The new enterprise is expected to cause the complete revival of the operations of every mine in the district, and means making possible the extraction of millions of tons of low-grade ore that heretofore would not permit of operation on account of expensive power. Mr. Hine has closed several large contracts for the supply of power to the mines. H. H. Filey, who was chief engineer in charge of the construction of the Mexican National Railroad, has been appointed superintendent of construction.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week just ended: Antwerp—9 pkgs. material, $418. Azores—1 pkg. material, $30. Amsterdam—27 pkgs. machinery, $449. British Possessions in Africa—25 pkgs. machinery, $1,729; 10 pkgs. material, $184; 5 pkgs. telephone material, $1,400. British Australia—36 pkgs. machinery, $2,250. British Guiana—9 pkgs. machinery, $1,890; 17 pkgs. material, $604. Brazil—7 pkgs. material, $212. Brussels—1 pkg. material, $10. Bristol—43 pkgs. machinery, $7,500. Bilboa—3 pkgs. material, $50. British East Indies—7 pkgs. material, $350; 12 pkgs. machinery, $1,005. British West Indies—56 pkgs. material, $2,218. Central America—45 pkgs. material, $3,821. Cuba—23 pkgs. material, $380; 1 pkg. machinery, $50. Chili—1 pkg. material, $70. China—10 pkgs. material, 135. Christiana—1 pkg. material, $45. Dutch West Indies—6 pkgs. material, $111. Dublin—2 pkgs. material, $100. Ecuador—9 pkgs. material, $199. Genoa—9 pkgs. material, $479. Glasgow—4 pkgs. material, $210. Hayti—3 pkgs. material, $84. Hull—2 pkgs. machinery, $90. Hamburg—10 pkgs. machinery, $850; 50 pkgs. material, $1,301. Havre—18 pkgs. machinery, $511; 5 pkgs. material, $96. Japan—127 pkgs. material, $10,203. Liverpool—226 pkgs. machinery, $17,319; 14 pkgs. material, $648. London—424 pkgs. machinery, $36,865; 155 pkgs. material, $5,006. Lisbon—20 pkgs. material, $1,124. Leeds—5 pkgs. material, $169. Mexico—159 pkgs. material, $2,297; 22 pkgs. machinery, $5,824. Newcastle—6 pkgs. material, $475. Philippines—88 pkgs. material, $7,725. Peru—17 pkgs. material, $1,131. Rotterdam—3 pkgs. material, $150; 7 pkgs. machinery, $855. Rome—87 pkgs. machinery, $5,000. Southampton—20 pkgs. material, $3,487; 4 pkgs. material, $130. Stockholm—1 pkg. machinery, $45. Turkey in Asia—3 pkgs. material, $92. U. S. Colombia—9 pkgs. material, $158.

ANOTHER MEXICAN WATER-POWER PROJECT.—In addition to the several large Mexican power transmission plants projected, with a view to supplying electric energy to the cities of Mexico, Guanajuato, Puebla, Toluca, etc., to which reference has already been made in the ELECTRICAL WORLD AND ENGINEER, the important city of Vera Cruz, it is anticipated, will shortly be supplied from a water-power plant, to be constructed 42 miles from that Mexican seaport. The initial equipment will be capable of developing from 10,000 hp to 15,00 hp. The energy is intended to be utilized for operating street railways and lighting in Vera Cruz, and for general purposes in some of the small towns in the vicinity. Francisco Hernandez has been granted the necessary concession.

THE CITY OF LOURENZO MARQUEZ, Portugese East Africa, will shortly have an electric traction system, the equipment, etc., for which, it is expected, will be purchased mostly in the United States. The contract has been awarded to the British Electrical engineering and contracting firm of Macartney, McElroy & Company, Havemeyer Building. Thomas Scott, chief engineer and general manager of the South Africa department of that concern, prepared the plans, etc. The concession for building and operating the road was originally granted to an American, J. C. A. Henderson. The Delagoa Bay Electric Tramways Company, Limited, has been incorporated for the purpose of carrying out the project. In the first instance it is proposed to construct about 12 miles of road.

THE A. G. SCHOONMAKER COMPANY, of 126 Liberty Street, New York, has received some of the largest orders that have been placed here of late for second-hand rebuilt electrical and other machinery. This company makes a specialty of hydraulic wheel presses for car shops, as well as other shop tools. Among the orders recently secured are: 22 trolley and trail cars, two 250-kw alternators, 18 pairs of traction trucks, two 120-kw alternators, 400 kw in transformers, a number of small motors, arc lamps, meters, repair jobs on generators, motors, cars, engines, etc., and two 150-ton wheel presses.

ELECTRIC POWER IN REVOLVER FACTORY.—The large revolver factory of Smith & Wesson, at Springfield, Mass., it is reported, will be operated by electric power provided the city council gives the firm permission to lay conduits through the streets for power transmission. D. B. Wesson, the head of the firm, has bought a valuable water power privilege at Barrets Junction, about 15 miles from Springfield. The power will be transmitted over a pole line the greater part of the distance.

CARS, ETC., FOR DURBAN.—The British electrical engineering firm of Macartney, McElroy & Company has secured a contract for some $50,000 worth of motor equipments, trucks, trolley wheels, overhead material, etc., for the Durban municipal road, South Africa. The contract will be filled in the United States. The J. G. Brill Company, of Philadelphia, recently obtained an order through the same British concern for eight cars for the Durban electric traction system.

HAWAIIAN CABLE.—It is stated from San Francisco that a landing place has been selected for the cable which John W. Mackay's Commercial Pacific Company is to lay shortly between San Francisco and Honolulu, close to the life-saving station, just north of Golden Gate Park. The terminus of the cable at this end will be in the offices of the Mackay Company, in the Hobart Building, on Market Street. Between this building and the beach landing place the cable will be buried in a trench or conduit. From the landing place mentioned the cable will pursue a southwesterly course to Honolulu. The total length of the cable will be about 2,100 miles. About $2,250,000 will represent the total cost. The actual work of laying the cable will begin next October. The construction of the great wire rope, or cable, is now going on at the mills at the rate of twenty miles a day. A steamer is already being fitted out for the purpose of laying the cable. The vessel will bring the cable from the mills in Great Britain, where it is being constructed, around Cape Horn to San Francisco, and proceed without delay with the work of laying it at the rate of six or seven knots an hour. The landing place at the other end will be about five miles from Honolulu. The line will be completed before Thanksgiving Day. General Manager Ward, speaking of the importance and significance of the new Pacific cable, said: "The company does not expect the San-Francisco-Honolulu cable to pay interest on the investment. The company aims to continue the cable on across the Pacific via Midway Island and Guam, to Manila and Japan. We are awaiting the issuance of the results of the Government steamer "Nero's" soundings between Honolulu and the Far East before going ahead with our work."

SAFETY CABLE ENTERPRISE.—An interesting pamphlet has been issued by the Safety Insulated Wire & Cable Company as to the proposed Trans-Pacific Cable, and raising the point whether it should be of American or foreign manufacture and whether it should not be under American control. The pamphlet, signed by L. F. Requa, president, and Ira W. Henry, chief engineer of the Cable department, says: "It is of vital importance to the United States that there should be established here, works suitable for the manufacture of ocean cables, so that when it is desired to renew existing American cables, or to lay new ones, either for commercial reasons or in time of war, all the facilities for doing this work in the best manner may be found within the United States. The company which we represent has already supplied and made cables for the United States Government, for use on the Atlantic, Gulf and Pacific Coasts. The Cuban war cable, laid and operated by the United States Government, was also made by this company, and there are over 1,300 nautical miles of submarine cable now laid and working in the Philippines, all of our manufacture, besides 250 miles about to be laid in the same waters. We are now making, for the Mexican Government, 472 miles of cable to connect Vera Cruz with Frontera and Campeche. Our company is prepared to undertake the manufacture of a Trans-Pacific cable."

GREENFIELD, MASS.—The stockholders of the Greenfield Electric Light and Power Company have voted to ask for permission to increase their stock from $30,000 to $100,000, and are ready to receive subscriptions for new stock, present stockholders having the first chance, but with so large an increase it is not probable that they will take it all. The plans of the company are not fully completed, but it has been decided to build a dam of concrete, 35 feet high, on which flashboards two feet high can be placed, giving a fall of 37 feet. The plan is to put in two generators, each directly connected onto the shaft of a pair of horizontal waterwheels, with sufficient power to generate from 1,000 to 1,200 hp, which is about four times the amount used. The cost of the new plant is estimated at $100,000, in addition to present investment.

UNITED TELEPHONE AND TELEGRAPH.—The management of the United Telephone and Telegraph Company gives the following figures as representing the assets and liabilities and profit and loss account of the company for the year ending March 31, 1902: Assets—Cost of original plants, $2,756,399; construction during year, $751,551; furniture and fixtures, $1,304; cash on hand, $23,885; total, $3,533,140. Liabilities—Capital stock, $1,617,387; mortgage bonds, $1,901,000; undivided profits, $14,752; total, $3,533,140. Profit and loss: Receipts—Telephone rentals, $182,596; toll line receipts, $3,015; other receipts, $2,469; total, $188,081. Expenses—Maintenance, $14,185; operation, $82,193; salary and office expenses, $8,935; interest on bonds and discounts, $6,814; surplus, $14,752; total, $188,081.

MACHINE TOOLS FOR LISBON TRAMWAYS.—The Companhia Carrie de Ferro de Lisbon (the Lisbon Electric Tramway Company, Limited, of Lisbon, Portugal), which concern is largely controlled by the Anglo-African house of Wernher, Beit and Company, and was built with American equipment, has placed a contract through the Morris Electric Company for a large lot of machine tools. The order calls for lathes, planers, drills, woodworking machinery, etc. Up to Tuesday, the Morris Company had not let any of the orders. It is stated that, owing to the great success of the Lisbon Electric traction system, which is the first electric road in Portugal, many of the leading provincial towns contemplate the adoption of electric motive power.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, has recently closed a contract with the Keystone Telephone Company, of Philadelphia, Pa., for a switchboard for their third district exchange. The switchboard will consist of seven sections, with an ultimate capacity of 3,000 lines, and a present equipment of 960 lines, 120 incoming and 120 outgoing trunk lines. Included in this contract are the necessary power apparatus, distributing frames, relay racks and the sneak-current and lightning-arrester equipment. The former is manufactured under one of the company's patents, and differs materially from former types, in that the heating-up process is not dependent upon the resistance of a coil of wire.

HAVANA CONTRACTS PENDING.—The Spanish-American Light and Power Company, Consolidated, is contemplating considerable extensions to its Havana plant. The company, of which Mr. T. J. Hayward, of Bartlett, Hayward & Company, 100 Broadway, New York City, is president, operates the only electrical plant in Havana outside that of the Havana Electric Railway Company. The contract for the requisite additional equipment, etc., will in all probability be given out direct from Cuba by R. Hermands Jimenez, the chief engineer of the company.

MM. F. ROUSSEL, of the Paris Municipal Council, F. Bienvenue, chief engineer of the Bureau of Bridges and Roads, also M. Locherer, one of the experts attached to the latter department, are now in the United States making a short inspection tour of electric traction systems. They are at present in Washington, D. C. According to present arrangements they will return to New York on Monday. While in this city they will be at the Holland House. These gentlemen return to France by "La Touraine," on May 22.

THE SPRAGUE ELECTRIC COMPANY has recently received an order from the Pennsylvania Steel Company for ten 5-ton electric trolley hoists, for use in the new bridge shop at Steelton, Pa. These hoists are of the new type of worm gear trolley hoists, manufactured by the Sprague Company. They combine great lifting capacity with remarkably light weight and unusual compactness. They are controlled from a cage and have a lifting speed of 20 feet per minute.

ARMATURE PRESS FOR BRITISH WESTINGHOUSE WORKS.—The British Westinghouse Electric and Manufacturing Company's plant, now being hastened to completion at Trafford Park, near Manchester, is to be equipped with a large armature press, which is intended to be used for shaping dynamos, etc. The machine, which has just left the shops of William Sellers & Company, of Philadelphia, weighs nearly 260 tons.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, which recently purchased the factory of the Strowger Automatic Telephone Exchange, with sole manufacturing and selling rights, under the Strowger patents, was last week apprised by a cable of the fact that the British Postal Department had authorized the installation of one of its automatic exchanges in the Post Office in London.

FIREPROOF CARS.—The Prussian Minister of Public Works, Herr von Thielen, has ordered experiments to be made with noncombustible passenger cars. These cars will have floors and walls chemically made fireproof, and seats stuffed with fireproofed cocoanut fibre, etc., and covered with asbestos. With electric light and heat, such cars ought to be very safe and comfortable.

STORAGE BATTERY FOR BERLIN, ONT.—Among the recent contracts secured by the Gould Storage Battery Company, of New York City, is one for the Berlin and Waterloo Street Railway Company, of Berlin, Ontario. It will consist of 255 cells with a 66-kw capacity and an allowance for 50 per cent. increase; together with regulating booster and switchboard.

CONDUIT CONTRACT.—Mr. G. M. Gest reports that the Cincinnati Gas and Electric Light Company has ordered 1,200,000 feet of American vitrified conduit duct, ranging from two ducts in the trench to 150. The latter has never been exceeded for mass, and requires a space 12 feet by 15.

AKRON ELECTRIC MANUFACTURING COMPANY, of Akron, O., has received contract for a new sheet steel mill plant at Niles, O., for the Surprise Iron and Steel Company, the generator to be run by a Brownell engine.

COAL FOR HAVANA ROAD.—The Havana Electric Railway Company has placed a contract with the Morris Electric Company, of 15 Cortlandt Street, for the supply of 30,000 tons of coal, which will be shipped from Philadelphia.

PLANT WANTED.—Mr. T. L. Smith, president of the Lighting Commission, Canandaigua, N. Y., is reported to be in the market for a plant of engines, boilers, dynamos, etc., to furnish 150 arc lights and 5,000 incandescents.

General News.

THE TELEPHONE.

SAN FRANCISCO, CAL.—Articles of incorporation of the Farallone Telegraph-Cable Company have been filed with the county clerk. It is proposed to establish a telegraph line from this city to a convenient point on the ocean shore near Point Lobos, and from that point a submarine cable extending to the Farrallone Islands. The capital stock of the company is placed at $75,000.

DOVER, DEL.—The Tontogany Mutual Telephone Company, of Tontogany, Ohio, has been incorporated under the Delaware laws to construct telephone lines in Wood County, Ohio; capital, $50,000.

BLUE RIDGE, GA.—The Blue Ridge Telephone Company has been incorporated, with a capital of $10,000, by J. H. Carter and others.

WAYNESVILLE, GA.—The Local Telephone Company of Waynesville expects to complete its connection with Asheville in the near future. The Bell company established long distance connections recently.

KNOXVILLE, ILL.—A franchise has been granted to the Gilson and Knoxville Telephone Company.

MARSHALL, ILL.—The Wabash Valley Telephone Company has increased its capital from $30,000 to $125,000.

GENESEO, ILL.—The Munson Telephone Company, capital, $500, has been incorporated by F. C. Swiger and others.

CHICAGO, ILL.—The Carbondale Telephone Company, of Carbondale, has been incorporated; capital, $5,000; incorporators: Joseph B. Bundy, Daniel B. Parkinson, and Daniel M. Parkinson.

ANGOLA, IND.—The Johnson Telephone Company will extend its line from Ashley to Waterloo.

CUMBERLAND, IND.—The Cumberland Telephone Company has incorporated with a capital stock of $10,000.

GAS CITY, IND.—The United Telephone Company has been granted a franchise to operate a system in this city.

MULBERRY, IND.—The Peoples' Co-operative Telephone Company of Mulberry has been granted a franchise for a town and rural system.

YEOMAN, IND.—A franchise for a telephone system in this town and the surrounding country has been granted to the Yeoman Co-operative Telephone Company.

INDIANAPOLIS, IND.—The Citizens Telephone Company (North division) has been incorporated to operate through Clay and Vego counties. The home office will probably be at Brazil.

INDIANAPOLIS, IND.—The Cumberland Telephone Company, of Marion county, has filed articles of incorporation. Capital $10,000. Joseph R. Ebaugh is president. The company will do a village and rural business.

INDIANAPOLIS, IND.—The Carrollton Telephone Company has filed articles of incorporation. The capital stock is $9,000. Louis J. Webber heads the board of directors. The exchange and home office will be located at Carrollton, Hancock county, Ind.

INDIANAPOLIS, IND.—The Lafontain Telephone Company, capital stock $5,000, has been incorporated to erect a plant at Lafontain and a rural system throughout Wabash county. Directors: T. H. Miller, John W. Harper, C. W. Stoner and L. B. Morris.

INDIANAPOLIS, IND.—Nearly $8,000,000 is invested in telephone property in this state, and the present season promises to be extraordinary in the development of existing plants and opening up of new fields. The New Telephone Company, of Marion, which was recently absorved by the United Telephone Co., has completed its buildings at Marion, and its business has extended beyond Company, has completed its building at Marion, and its business has extended beyond all expectations. The Citizens Telephone Company, of Columbus, has doubled its capacity in the past year. It will be recalled that the Merchants' Association at Columbus decided to discontinue the use of the Bell instruments after May 1, going on record as against two systems in one town. The exchange at Logansport is practically completed. The company now has over 1,000 contracts. The new exchange at Peru is about ready for operation. Much of the remarkable development in the telephone business is stated to be due to the independent telephone movement, and among those who have furthered such enterprises none deserves more credit than Hon. S. P. Sheerin, of Indianapolis, who is styled the "Father of Independent Telephony in Indiana."

EVANSVILLE, IND.—The revising committee has given out the full details of the proposed municipal ownership of the telephone system for this city. In the main it differs but little from the original scheme given out. Whatever changes are made are of a character to overcome legal objections. The plan is to issue preferred and common stock. The former is to bear 7 per cent. interest. It is proposed to obtain the money from the sale of this stock with which to build the plant. Of the common stock the city is given $197,500 as a compensation for a twenty-five years' franchise. It is the purpose to redeem the preferred stock with the earnings, and thus gradually and ultimately the city will own the system. The prices for telephones are placed at not less than $3, nor more than $4, a month for individual lines in business houses; $2 for individual lines in residences; $1.50 for two on a line; $1 for four on a line in residences. In case of party lines a new device will be used by which if one person on a line is using the telephone, all other parties are cut off. The wires are to be all hard drawn copper wires, and must be placed under ground in the fire limits. The matter is now in the council, and a royal fight is anticipated. The promoters and advocates admit that the scheme is not regarded as favorably as it was a few weeks ago. The local system is fighting the scheme hard.

DAVENPORT, IA.—The Iowa Telephone Company has been incorporated, with a capital of $4,000,000.

CLEAR CREEK, IA.—The farmers of this vicinity have decided to form a mutual telephone company.

MEDIAPOLIS, IA.—The Mutual Telephone Company of this place has incorporated, with H. Breder, president. Capital, $10,000.

WAYLAND, IA.—The Wayland Telephone Company has been incorporated with a capital of $3,000, by G. W. Hebel and others.

CHEROKEE, IA.—The Sioux Valley Telephone Company has incorporated, with a capital stock of $50,000. M. S. Harter is one of the directors.

BEATTIE, KANS.—The Farmers Mutual Telephone Company has been chartered, with a capital of $1,000.

SUMMERFIELD, KANS.—The Summerfield Mutual Telephone Company has incorporated with a capital of $1,000.

SHEPERDSVILLE, KY.—The Victoria Telephone Company has been incorporated by R. S. Hall and others.

NICHOLASVILLE, KY.—The Home Telephone Company is building a number of new toll lines in this vicinity.

LOUISVILLE, KY.—The Salt River Telephone Company has been incorporated in Bullitt county. Wood Ash is one of the incorporators.

LOUISVILLE, KY.—The Louisville Home Telephone Company has executed a mortgage to the American Trust & Savings Company, of Chicago, for $2,500,000, covering its entire property. The mortgage covers bonds to the same amount, of which $1,150,000 will be issued at once, and the balance when needed. The bonds bear 5 per cent. and are due July 1, 1922.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company's exchange increased during its first six months from 480 to 780 telephones in service, a gain of about 62 per cent. The half year's business shows net earnings (after charging depreciation) at the rate of 6 per cent. on the capital stock. The rates are low and the quality of service high. Private lines, unlimited service and the special features of the automatic system are enjoyed by all subscribers. The underground system, pole lines, building and switchboard have an ultimate capacity of 3,000 lines, and, therefore, a large part of the plant is not yet productive. Telephone competition is highly appreciated in Fall River.

GRAND RAPIDS, MICH.—The Citizens Telephone Company will erect a new exchange here.

IRONWOOD, MICH.—An independent telephone company has applied for a franchise, and the request will probably be granted.

HOLLAND, MICH.—The Zeeland and Hamilton lines of the Citizens Telephone Company will be rebuilt, and the service between Holland and these places greatly improved.

WATERLOO, MICH.—The Waterloo Rural Telephone Company has decided to reincorporate and increase its capital stock from $10,000 to $20,000. The company will build a line from Stockbridge to Howell.

ALBION, MICH.—The business men's committee has issued a public announcement to the effect that over 250 of the 300 subscribers necessary to start a telephone exchange upon a paying basis, have already been secured, and that as soon as the remaining number are secured they will feel that it is proper to go ahead with the organization of the company. The 300-mark is expected to be reached within a few days.

ST. PETER, MINN.—James Bennett proposes to extend his telephone line to Cleveland.

MAYWOOD, MO.—The Maywood Telephone Company has incorporated, with a capital stock of $5,000.

HUMPHREY, NEB.—The Humphrey Telephone Company will erect a line from Oldenbusch to this place.

WEEPING WATER, NEB.—The Plattsmouth Independent Telephone Company is constructing an exchange here.

LINCOLN, NEB.—The Duel Telephone Company, of Duel county, has been incorporated, with a capital of $2,000, by B. E. Fish and others.

CHATHAM, N. J.—A local telephone system, to be owned by the borough, is under consideration.

NEWARK, N. J.—The Warren Telephone Company is extending its lines through Hopatcong, Lopatcong and Greenwich townships.

SUSSEX, N. J.—The Farmers Union Telephone Company, of Sussex, N. J., has been incorporated; capital, $10,000. Incorporators: Warren D. Haggerty, William S. Vanderhoff, John D. Haggerty, Merritt L. Haggerty, Owen J. Little, Gabriel Lublum, Frank E. Armstrong, Charles A. Coykendall, Christopher P. Stanaback, Charles Ayers.

FRANKLINVILLE, N. Y.—Mr. Virgil Hayden will build an independent telephone line from Franklinville to Farmersville Center, Farmersville Station, Fairview and Sandusky, which will connect the Franklinville Telephone Company's lines with those of the Wyoming and Cattaragus Telephone Company at Arcade, all in New York State.

UTICA, N. Y.—The New Berlin Telephone Company has increased its capital stock from $3,000 to $10,000. The amended certificate allows it to extend its lines in six different counties, as follows: Chenango, Otsego, Delaware, Madison, Oneida, and Herkimer, and also to join other corporations. Private lines are to be connected along the line. Work on some of the proposed extensions has been started.

CORTLAND, N. Y.—Articles of incorporation for the Tioughnioga Telephone Company, with a capital stock of $30,000, have been filed at Albany. The new company is formed by Cortland capitalists to act in connection with the Cortland Home Telephone Company for the purpose of constructing toll lines through this and other counties to connect with the Home company lines in other cities. William Martin is president of the company.

ASHEVILLE, N. C.—The Asheville Independent Telephone Company has completed its long distance line to Hot Springs.

SANDUSKY, OHIO.—The Sandusky Telephone Company is now lighting its exchange with Nernst lamps.

STRYKER, OHIO.—The Stryker Telephone Company has been incorporated, with a capital of $10,000, to build a local independent telephone system.

MANTUA, OHIO.—The Mantua Telephone Company has commenced operations with 100 telephones, and others will be installed in the near future.

IRONTON, OHIO.—The system of the Lawrence Telephone Company at Ironton is to be thoroughly rebuilt, and a central energy exchange installed.

CHEATALL, OHIO.—The Acme Telephone Company, which is building a line through Cheatall, is securing a large number of farmers' subscriptions.

MENTOR, OHIO.—The Mentor Home Telephone Company is rapidly reaching the limit of its switchboard capacity. Improvements will be necessary before many months.

COOLVILLE, OHIO.—The Coolville Home Telephone Company is building a line to Belpre. A line will be strung across the Ohio River, giving connection with many points in West Virginia.

FINDLAY, OHIO.—The Findlay Home Telephone Company will spend about $50,000 in improving its system. The capacity of the plant will be almost doubled to take care of the rapidly growing business.

CINCINNATI, OHIO.—The Interstate Telephone Company, of Cincinnati, has been incorporated, with $20,000 capital stock, for the purpose of constructing a telephone line from Cincinnati to Hamilton.

CANTON, OHIO.—It seems probable that the local parties who propose to buy up the system of the Stark County Telephone Company will be successful, as good progress is being made in securing subscriptions for the new stock.

PUT-IN-BAY, OHIO.—John Holloway, of this place, is at the head of a company which will establish an exchange on the island. Connection with the main land will be effected through the cable which was laid last year. The Central Construction Company of Toledo will build the exchange.

BATAVIA, OHIO.—The Central Union Telephone Company is about to connect up every village in this county. Rates are $1 per month for farmers' lines, and a large number of these will be installed. This rate gives free county service and a 20 per cent. discount on toll business to Cincinnati.

TOLEDO, OHIO.—The success of the Toledo Home Telephone Company seems assured. Contracts for 6,043 subscribers have been secured, and the plant will be placed in operation about June 1, with 7,000 lines. The company has an authorized capital stock of $2,500,000, but has issued only $800,000. It has bonds outstanding of $800,000.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Telephone Company has increased its capital stock to $30,000, with a number of leading business men as stockholders. This step was made necessary for the remodeling of the plant. The officers are: G. W. Hale, president; Anna Osborn, vice president; Charles Juvinal, manager, and M. H. Brinkerhoff, secretary.

WELLSVILLE, OHIO.—The Pennsylvania Railway Company has submitted a proposition to both of the local telephone companies, with a view of installing an exchange in the round house and connecting the homes of all the engineers employed on that division, thus doing away with the service of call messengers.

CLEVELAND, OHIO.—H. D. Critchfield, who has had charge of all negotiations looking towards the sale of the Federal Telephone Company's properties, states that the report indicating that the company is about to dispose of the property of the United States Telephone Company is wholly without foundation. The United States long distance lines could not be sold without crippling the system, and there is no possibility of their being sold except as the Federal Company might be sold as an entirety, and the possibility of this step is now quite remote in view of the fact that negotiations are pending looking to the sale of several of the individual exchanges to home parties.

CLEVELAND, OHIO.—The deal for the sale of the Everett-Moore interests in the Federal Telephone properties at Columbus and Dayton has been consummated. Under the terms of the deal the syndicate, composed of Dayton and Columbus people, headed by H. A. Lanman, of Columbus, and John T. Barlow, of Dayton, secured the absolute ownership of the uncompleted Dayton plant and the control of the Columbus plant. The Dayton plant is understood to have sold for $90,000, while 2,200 shares out of the 5,650 shares of the Columbus stock owned by the Cleveland people are understood to have brought about $100,000 more. The deal gives the new parties the control of the Columbus plant in consideration of which they agreed to spend $300,000 in placing the system in first class order. A new sub-exchange will probably be erected to take care of between 2,500 and 3,000 subscribers, nearly 1,000 of which are already on the waiting list. The Dayton plant is to be completed at once and placed in first class condition. It is understood on good authority that the terms of the sale of the Columbus interests provided an option whereby the Everett-Moore syndicate may repurchase the stock at the sale figure, plus interest and minus dividends which the company is declaring.

MADILL, OKLA.—The Chickasha Telephone Company is asking for a franchise in this place.

SLATINGTON, PA.—The Citizens Telephone & Telegraph Company, capital $5,000, has been incorporated.

CANOVA, S. D.—The Canova Telephone Company has incorporated, with a capital of $2,000; E. C. Goeckle and others are the incorporators.

JACKSON, TENN.—The Jackson Telephone Company has organized, with A. D. Hay as president. The capital is $100,000.

MEMPHIS, TENN.—The Deer Creek Telephone Company, domiciled at Patmos, Yazoo county, has been incorporated to build a line of telephone from Luca to Rolling Fork; capital stock, $600. Incorporators are: H. G. Thornell, O. Thornell, James N. Screws, and others.

AUSTIN, TEX.—An amendment to the charter of the Farmers & Merchants Telephone Company of Henrietta, Tex., increasing its capital stock from $2,400 to $4,800 has been filed.

SPOKANE, WASH.—The Sunset Telephone Company will extend its lines to Lynden, Everson, Nooksack and Dumas.

SEATTLE, WASH.—The Northwest Telephone Company has been granted a franchise by the city council, and will begin work at once on the installation of a system here and at Everett.

MORGANTOWN, W. VA.—The People's Telephone Company has issued $10,000 worth of new stock, and will use the money in extending its lines.

CATLETTSBURG, W. VA.—The new independent telephone system has commenced operations, with 200 subscribers. The line to Huntington will be completed in a short time, giving through connection from Ironton, Ohio, to Huntington and Charleston, W. Va.

MILWAUKEE, WIS.—The Wisconsin Telephone Company is planning to place its wires underground in the sixth ward.

WATERTOWN, WIS.—The Wisconsin Telephone Company will expend about $10,000 in Watertown putting in new telephone lines, etc.

LEEDS, WIS.—The Leeds Farmers Telephone Company, with a capital of $5,000, has been incorporated by George Krondoke and others.

ORFORDVILLE, WIS.—The Orfordville Telephone Company has incorporated with a capital stock of $10,000, and will establish a system in Orfordville.

SANTIAGO, CHILI.—The Chilian Government is asking for tenders for the work of laying an ocean cable to the Straits of Magellan, starting from Talcahuano, Chili.

OTTAWA, ONT.—Replying to a question in the Dominion house of commons, the minister of agriculture stated that there are 113,294 miles of telephone lines in Canada. There are 55 telephone companies in the Dominion, of which 44 are in operation; 25 in the province of Quebec, 7 in Ontario, 6 in Nova Scotia, 5 in New Brunswick, 8 in British Columbia, 2 in the Northwest Territories, and 1 in Prince Edward Island. The Bell Telephone Company has 94,314 miles in operation in the provinces of Quebec, Ontario, Manitoba, and the Territories. It has no unissued stock.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CAL.—The Nevada Power, Light & Water Company is spending $40,000 in rebuilding its system in Reno, Nev. An additional 400-kw. Westinghouse generator is to be installed.

SAN FRANCISCO, CAL.—Construction work is in progress at the new electric power station of the San Antonio Water Company, in the San Antonio canyon, California. Ontario, Pomona and other towns will be supplied with current. Two 500-hp. units will be installed at first.

SAN FRANCISCO, CAL.—The Mariposa Commercial & Mining Company has completed the electric transmission plant, which supplies power for its mine at Mt. Bullion, Mariposa county, Cal. A 600-hp. Westinghouse generator is operated by water power derived from the Merced River. The distance of transmission is 25 miles.

SAN FRANCISCO, CAL.—President John A. Britton, of the Oakland Gas, Light and Heat Company, is acting as consulting engineer for the United Gas & Electric Company, and is preparing specifications for the gas pipe line that is to be laid from San Jose to San Mateo.

SAN FRANCISCO, CAL.—As soon as the United Gas & Electric Company has completed the consolidation of the Electric Improvement Company, the San Jose Light & Power Company and the Consolidated Light & Power Company, it is said that the electric rates will be reduced. The rate in San Mateo and Santa Clara counties will be 10 cents per kilowatt hour, which is a reduction of from 30 to 50 per cent.

SAN FRANCISCO, CAL.—The Nooksack Falls Power Company recently closed a contract for its initial installation, through the Westinghouse Electric & Manufacturing Company's San Francisco office. There will be one 1500-kw. revolving field type generator, which will have a speed of 230-rpm. Current will be transmitted to Whatcom, Wash., a distance of about 45 miles. An electric railroad to be built in the Cascades mountains by the Bellingham Bay & B. C. Railroad Company will be operated from this plant. It is intended to install a second 1500-kw unit next year, and to extend power lines to Everett and other cities.

DOVER, DEL.—A certificate of incorporation has been issued to the Tonopah Water & Power Company, of Carson City, Nev., to furnish water and electric light plants and to do a general mining and milling business; capital, $1,500,000. Incorporators: Lewis H. Rogers and J. L. Yerington, Carson City; J. H. Daskell, Sandy Hill, N. Y.; J. F. Gardner, Brooklyn, N. Y.

ALBION, IDAHO.—An electric light plant has just been installed in Albion and is meeting with much success.

ALTON, ILL.—A 500-hp. electric plant is being installed by the Illinois Glass Company. The machinery will be operated by electric power.

PENDLETON, IND.—The city council has decided to install an electric light plant.

UNION CITY, IND.—The city council has accepted the new electric light plant erected by Messrs. Ulen & Parrott, of Indianapolis, for $48,000.

MOORE'S HILL, IND.—F. R. Philips is taking up the matter of constructing an electric light plant for this town. The prospects are that the plant will be built this spring.

PLYMOUTH, IND.—The Simons electric light plant of this place was entirely destroyed by fire. Six days after the fire the plant was rebuilt, and is now in full operation. Before the fire was hardly out plans were made, and machinery was ordered by telegraph.

ANDERSON, IND.—A schedule of lower prices for electric light went into effect here May 1. The new rate reduces the old figures about one-half. All the contracts are based on the meter system, and the price is now nine cents per kilowatt hour, and four and a half cents an hour for each incandescent lamp.

VAN HORN, IA.—Mr. J. A. Wicke has secured an electric light franchise in this place, and expects to have the plant in running order in sixty days.

GRINNELL, IA.—The Grinnell Electric Light Company has sold its plant to the Grinnell Electric & Heating Company, a new company which will thoroughly overhaul the plant and secure a new franchise from the town. The new company consists of Dick L. Benson, who will be vice-president and general manager; C. C. Jamison, of Muncie, Ind., president; Tasso A. Meyers, of Chicago, secretary; and F. W. Willson, of Muncie, Ind. The company has made a proposition to the town to pump water for $500 less per year than it is at present costing the town to run an independent steam plant. In addition to overhauling and rebuilding the electric light and steam heating plant and putting in a fuel water purification plant, an all day power and light service will be maintained.

OAKLAND, ME.—Contracts have been consummated by which the water power of the Messalonskee River at this place is to be improved. The Dunn Edge Tool Company and the Messalonskee Electric Company will construct the necessary power houses, etc. It is estimated that 1,000 horse power will be developed. Of this 400 horse power will be used by the Electric Company and 600 horse power by the Edge Tool Company.

HANNIBAL, MO.—The Canton Electric Company has brought suit in the United States Circuit Court to restrain the town of Canton, in Lewis county, Mo., from issuing bonds for $20,000 for a municipal electric lighting plant. The plaintiff was granted a franchise in 1891 for 20 years, and the town was to take a certain number of street lights at an agreed price. The affidavit alleges that the action of the city in establishing a plant is contrary to the franchise and the ordinances.

HOLLAND, MICH.—The council has voted to issue $55,000 bonds for the extension of the municipal water works and lighting plant. The improvements are to be made at once.

ALBANY, N. Y.—The Piermont Illuminating Company, Orange, Rockland County, has been incorporated; capital, $25,000. Directors: G. H. Sanford, Bridgeport, Conn.; E. F. Glover and F. W. Brecht, Brooklyn.

SYRACUSE, N. Y.—The Seneca River Power Company has purchased the Edison Illuminating Company of Baldwinsville, and will spend $40,000 in improving the plant. The company has been incorporated to operate in the towns of Baldwinsville, Solvay, Warner, Memphis, Camillus, Elbridge, Geddes, Lysander, Salina and Van Buren, Onondaga county, and Phoenix and Schroeppel, Oswego county. It is rumored that the Westinghouse Company is back of this purchase, and that that company will establish a power plant in Baldwinsville and buy the Syracuse, Lakeside & Baldwinsville Railway, and extend that road to Oswego. It is said that there is enough power to be obtained from the Seneca River to run the light plant and the railway.

CANTON, OHIO.—The Canton Gas & Electric Company is installing a new engine in its power house, and will increase its boiler capacity.

COLUMBUS GROVE, OHIO.—The council has passed an ordinance for the issue of $15,000 of bonds for the purpose of purchasing the municipal lighting plant.

WAPAKONETA, OHIO.—The annual report of the electric lighting plant indicates that during the past year the 79 arc lamps in service cost an average of $26.08 each.

COLUMBUS, OHIO.—Mr. Clak Doughty and others are engineering a proposition to build a theater and electric lighting plant. It is proposed to install a plant of 1,000 lights capacity.

COLUMBUS, OHIO.—Dr. Gladden has introduced a measure in the council providing for the issue of $175,000 worth of bonds for a new municipal lighting plant. Director Immel announces that work will start at once on the construction of the plant. The present contract with the Columbus Electric Light & Power Company expires Sept. 1, and as soon as the new plant can be completed, all the lights will be furnished by the city.

BAKER CITY, ORE.—The Baker City Gas Light & Electric Company, of Baker City, has been sold to capitalists represented by J. J. Henry, of Denver. The plant will be remodeled and its capacity increased.

SALEM, ORE.—The Tucker Power Company, which was recently incorporated in Salem, Oregon, with a capital stock of $75,000, will construct electric power plants for lighting, etc. The incorporators are B. B. Tucker, J. J. Crofut and others.

HARRISBURG, PA.—The Harrisburg Electric Light, Heat and Power Company is preparing to use Paxton creek water for power in place of the water power which it had from the Pennsylvania canal at Walnut and Ninth streets.

KNOXVILLE, TENN.—It is announced by the promoters of the Knoxville Power Company, among whom are R. W. Austin and Gen. J. T. Wilder, of this city, that work is to be begun during May on the dam across Little River, in Blount county, from which electrical power is to be generated. Beside the dam a railroad over twenty miles in length is to be constructed and an investment of between $2,000,000 and $3,000,000 made.

NASHVILLE, TENN.—The Cumberland Electric Light & Power Company will erect a new power station in this city, for which purpose it has recently bought a site adjoining the city plant. A fireproof building 110x300 feet will be erected. The equipment will include six batteries of boilers of 700-hp. each. A railway generating unit of 1600-kw. capacity, direct-connected to a 2,500-hp. Green-Wheelock cross-compound condensing engine will also be installed. The electric light load will be taken care of by a 1,250-kw generator driven by a 1,600-hp Green-Wheelock engine. The generating apparatus will be of the General Electric Company's make. The engine house will be spanned by a 60-ft. crane, of a carrying capacity of 25 tons.

AUSTIN, TEX.—The Sodemann Heat & Power Company, of St. Louis, Mo., with a capital stock of $25,000, was granted a permit to do business in Texas.

EAST TROY, WIS.—The city is considering the proposition of establishing an electric lighting plant. Engineers have made estimates of the probable cost.

MILWAUKEE, WIS.—The south side business men will ask the common council for an electric lighting franchise to cover a territory about a mile square.

MILWAUKEE, WIS.—The common council has passed a resolution favoring the erection of a municipal electric lighting plant, with a capacity of 2,500 arc lights, on Jones Island.

MONTREAL, CAN.—It is practically decided that electricity will be the chief motive power employed in the new work shops of the Canadian Pacific Railway at Montreal. The engineers estimate that the works will require from 800 to 1,000 horse power.

QUEBEC, CAN.—The Basilica of La Bonne Ste. Anne, in the province of Quebec, and famous for the wonderful cures which have been effected at its altars, will be one of the most brilliantly lighted churches in America. Nearly $20,000 is being spent in introducing into it over 1,500 electric lights, of which some 600 will be on and around the high altar alone.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Monterey & Pacific Grove street railway line has been purchased by J. M. Gardiner and associates, of Los Angeles, Cal. They intend to begin very soon the work of converting the road into an electric line. The same capitalists will also build an electric road from Santa Cruz to Capitola.

WILMINGTON, DEL.—The corporators of the Delaware Electric Traction Company, which proposes to build a trolley line through Kent county, have perfected organization. Senator J. Frank Allee was chosen president; Senator S. John Abbott, vice-president; Representative Thomas C. Moore, secretary; and Secretary of State Caleb R. Layton, treasurer. These officers, with Dr. Luther S. Conwell, of Camden, and Insurance Commissioner George W. Marshall are the directors of the company. A survey of the route from Smyrna to Milford, and from Smyrna to Woodland Beach was ordered. The line will be 35 miles long. The contract for its construction has been awarded to the Milford Construction Company, chartered recently in New Jersey. That concern will sublet contracts to parties in Baltimore and New York.

ROCK FALLS, ILL.—The end of the year 1902 will see all of the larger cities of Northern Illinois connected by electric railways, representing a cost of $3,000,000. The Rock River Valley Electric Railway will extend from Rock Falls to Rockford, 50 miles, passing through Sterling and Dixon. Another road is being planned from Dixon to DeKalb and from DeKalb to Sycamore. Plans are under way to build an electric road from Rockford to Janesville, Wis. The entire system will cover several hundred miles.

FRANKLIN, IND.—The commissioners have granted a franchise to the Indianapolis & Waverly Interurban railway through Johnson county to Waverly.

SHERIDAN, IND.—The commissioners have granted to H. E. Davenport and others, of this city, a right of way to build an electric railway from Sheridan to Carmel, a distance of eleven miles.

NEW CASTLE, IND.—A subsidy in aid of the New Castle & Pendleton Electric Railway was voted by the citizens of Henry Township, while the subsidy was defeated in Harrison Township adjoining.

RICHMOND, IND.—The Dayton & Richmond Traction Company has organized with William Ammon, Potsdam, Ohio, president; A. C. McDonald, Dayton, secretary, and H. G. Cress, Dayton, treasurer.

CORYDON, IND.—A movement is on foot backed by the Commercial Club of this city to build an electric line from New Albany to Leavenworth, by way of this place. H. B. Chilcote is president of the association having the undertaking in hand.

LAFAYETTE, IND.—At a recent meeting here of the directors of the Lafayette City Railway Company and George F. McCulloch, E. T. Griffiths and J. L. Jones, of Philadelphia, arrangements were made to merge interests and build a line to Logansport by way of Delphi.

ALBION, IDAHO.—A correspondent writes that there is an excellent opportunity for an electric railway between this place and the Oregon Short Line Railroad. In the vicinity are a large number of lead and silver mines, and it is believed that the district will become the greatest farming section of Idaho. There is plenty of water power in the immediate vicinity.

GARDINER, ME.—Maine electric railway builders are considering the plan of constructing a line between this city and Brunswick. This line would render it possible to travel entirely by trolley from Augusta to Biddeford, a distance of about 75 miles, the longest continuous run in the State.

LANSING, MICH.—The Mason & Oceana Railroad Company has increased its capital stock from $80,000 to $300,000.

NEWARK, N. J.—Architect Thomas Cressey is now busy with his plans for an extensive addition to the power house of the North Jersey Traction Company on River street. It will take fully a year to build the addition. The addition will be 100 by 225 feet in dimensions, and will comprise a boiler house and engine room. In the new boiler house there will be thirty-six boilers of 250-horse power each. In the engine room will be six large engines, thirty-eight feet high, and there will be space above them for a traveling crane. A large new brick stack will be built with a fifteen-foot flue. The stack will be 250 feet tall.

TROY, N. Y.—Fred Howe, of New York City, representing New York parties, is securing consent of property owners for the construction of an electric road from Port Kent to Keeseville, Ausable Forks, Jay, Upper Jay, Keene Center, Cascadeville and Lake Placid.

NEW YORK, N. Y.—The New York and North Shore Railway has been sold at auction to Mr. E. Clarence Miller. The price paid was $100,000 over and above the liabilities. The mortgage, it is stated, was held by the New York Security and Trust Company. The properties comprise the trolley line between Flushing and Jamaica and numerous franchises for trolley lines in the borough of Queens as far as Manhasset and Whitestone and other points. The sale included the tracks, franchises and rolling stock of the company.

WILMINGTON, N. C.—The work of converting the Seacoast Railway into a trolley line is expected to begin within two weeks and to be completed by August.

DAYTON, OHIO.—The Peoples' Railway Company is planning a number of improvements for its city system this summer.

MARION, OHIO.—The Mt. Gilead, Mt. Vernon & Western Railway Company has been granted a franchise in this town.

TROY, OHIO.—The bid of the Springfield & Western Railway for a line into the center of the town has been accepted.

COLUMBUS, OHIO.—The city has approved the plans for the construction of the Central Market Railway, and work is being pushed.

SOUTH CHARLESTON, OHIO.—The Dayton, Springfield & Urbana Railway has secured a franchise for its proposed branch line through this place.

MEDINA, OHIO.—The Medina Electric Power & Light Company is temporarily furnishing power for the southern end of the Cleveland & Southern Railway.

TROY, OHIO.—W. S. Thomas and R. J. Smith, of this place, are interested in an electric railway project in South Carolina. The road will connect Charleston with Summerville.

FINDLAY, OHIO.—Western capitalists are looking over the route from Findlay to Defiance with a view to building an electric railway to connect with the Findlay & Marion line.

PIQUA, OHIO.—Superintendent Bidwell, of the Miami Valley Electric Railway Company, states that a number of important improvements are to be made on the line this summer.

TOLEDO, OHIO.—The Arbuckle-Ryan Company, of Toledo, has secured a contract for the overhead work and the steam plant for a new line to be built from Flint to Grand Rapids, Mich.

MARION, OHIO.—It is stated that a deal has practically been effected whereby the Marion Electric Street Railway Company is to be absorbed by the new Findlay-Marion Company.

DAYTON, OHIO.—It is stated that a deal has practically been closed whereby the Miami Valley Railway, operating between Troy and Piqua, will be sold to the Winters-Clegg syndicate, owner of the Dayton & Troy Electric Railway.

CANTON, OHIO.—Motormen and conductors of the Canton-Massillon Railway have received an increase in pay. The new rate is 17 1-2 cents for new men and 20 cents after two years. The old scale was $1.65 per day for nine hours.

COLUMBUS, OHIO.—The Columbus, London & Springfield Railway Company has filed a mortgage on its property for $1,500,000 to secure an issue of bonds. The mortgage is in favor of the Continental Trust Company of New York.

CINCINNATI, OHIO.—The Interurban Terminal Company of Cincinnati has been incorporated with $500,000 capital stock by G. W. Scrugham, George H. Worthington, J. M. Kennedy, Lee H. Brooks, W. E. Hatton, C. H. Davis, and E. W. Mallon.

THE AUTOMOBILE.

INDIANAPOLIS AUTOMOBILE CLUB.—An automobile club has been organized at Indianapolis, Ind., with H. T. Hearsey as president.

MILE RECORD CONTEST.—The Automobile Club of America will hold its annual mile record contest on the South Shore Boulevard, Staten Island, N. Y., on May 31, at 11 a. m. Mr. A. C. Bostwick is chairman of the racing committee.

NEW INDUSTRIAL COMPANIES.

THE THOMPSON-BONNEY COMPANY, of Brooklyn Borough, New York, has been incorporated to manufacture electrical apparatus; capital, $30,000. Directors: C. A. Thompson and J. P. Bonney, Brooklyn; Frank Lippert, New York.

THE EMPIRE STATE ENGINEERING COMPANY, of New York, has been incorporated, with a capital of $500,000 to manufacture stationary and locomotive engines and motors. The directors are M. P. Marks, Albert G. Kalb, Harry J. Marks, Kenneth C. Kirtland, T. C. Press and Malcolm V. Ryan.

LEGAL.

THREE-CENT FARE CASE.—The Indiana Supreme Court has held as valid and constitutional the law under which the charter and franchise of the Indianapolis Street Railway Company was granted. This practically declares invalid the 3-cent fare law of 1897. A Mr. Smith brought suit against the company for damages for being ejected from a car for refusing to pay more than three cents.

WESTERN ELECTRIC VS. KINLOCH.—A motion to stay the order for an injunction was argued last week in the United States Circuit Court, at St. Louis, in the case of the Western Electric Company against the Kinloch Telephone Company. The motion, however, was denied, but the defendant was given until May 19 to install new devices. The injunction was ordered some weeks ago to restrain the Kinloch Telephone Company from the use of a patented device on its switchboards.

IN FAVOR OF KEYSTONE COMPANY.—A Philadelphia despatch states that Judge Dallas has handed down an opinion in the United States Circuit Court refusing the motion of the Western Electric Company for a preliminary injunction to restrain the Keystone Telephone Company from making an alleged infringement of certain patented improvements in multiple switchboards for telephone exchanges, which the Western company claimed to own exclusively. In his decision the Judge refers to the previous case decided in the United States Court in Missouri, and says the construction of the patent is different and important additional evidence has been submitted.

STREET RAILWAY FRANCHISES.—The Wisconsin Supreme Court, in a recent opinion, decided that street railway franchises cannot be granted to individuals. This important interpretation of the statute was announced in an action brought against G. L. Clausen and P. F. Haynes to restrain them from building a street railway in Kenosha, after having received a franchise from the city council. It is the general opinion that franchises held by individuals will have to be transferred to corporations at once, and that the authority for such transfer will have to be secured from the grantors. A number of street railway franchises are now in the hands of individuals, and one of the roads affected by the decision is that about to be constructed from Madison to Janesville.

OBITUARY.

JOHN H. EMERICK, for many years general superintendent of the Postal Telegraph Company, at New York, died at his home in Brooklyn on the night of May 11, at the age of 57 years. When 17 years of age he entered the military service at Gen. McDowell's headquarters in Virginia in 1861, and served through the war as operator with the Army of the Potomac. In January, 1865, he was made chief operator of the Army of the James. He was one of the twelve military telegraphers who were presented with watches by Edwin M. Stanton.

FRANK R. COLVIN.—We regret to announce the sudden death at his residence, Roselle, N. J., last week of Mr. Frank R. Colvin, the telephone engineer and expert. He was only forty years of age, and had but just returned from a trip in apparent excellent health, but was subject to heart trouble. Mr. Colvin was a graduate from the U. S. Naval Academy, and a close personal friend of the late S. Dana Greene, whose class he was in. Shortly after leaving the naval service in which little opportunity offered before the development of the "new navy," Mr. Colvin became associated with Mr. F. J. Morrison and the old Baxter Electric Motor Company. He then entered the office of the *Electrical World*, and shortly after became business manager of the *Electrical Engineer*, when it was made into a weekly. He had always taken a deep interest, however, in the technical end of electrical work, and had been associated with some of the earliest electric lighting done in the navy. He now devoted much attention to telephony, took out some patents, and went into telephone manufacture for private exchange installations. His interests were acquired by the Western Electric Company, and he was retained by Barton & Brown, of Chicago, as an expert for special work in connection with Bell telephone infringement cases. Mr. Colvin was a man of marked ability, great insight into technical questions, and had an unusual grasp of the intricacies of telephone circuits. He leaves a widow. The funeral took place on Monday of this week. The services were strictly private, only those intimately acquainted with Mr. Colvin, or close business associates, being notified. Following the ceremony of the Episcopal Church, interment took place at the Elizabeth, N. J., cemetery. Among those present were Messrs. A. S. Salt, J. H. Barnard, F. Kortheuer, Joseph Wetzler, Harry S. Smith, John J. Carty, and A. C. Boughton, of *Electrical World and Engineer.*

DR. HENRY MORTON.—We note with deep regret the death of President Morton, of the Stevens Institute of Technology, long one of the foremost technical educators in this country. He was born in New York Dec. 11, 1836, and was the son of the Rev. Henry J. Morton, who for fifty-six years was rector of St. James's Episcopal Church, Philadelphia. He was graduated from the University of Pennsylvania in 1857, and after studying law abandoned the idea of practicing it, and devoted himself to the study of chemistry, physics and mechanics. He became an instructor in the Episcopal Academy of Philadelphia, where his lectures became so famous that he had to deliver an extra course for the public. In 1863 he was elected professor of chemistry in the Philadelphia Dental College, and in 1869 the new chair of chemistry was created for him at the University of Pennsylvania. In the same year he took part in the expedition sent out by the United States Nautical Almanac office to observe the total eclipse of the sun on Aug. 7, and in connection with these observations was the first to prove the true nature of the bright line on the sun's disk adjacent to the edge of the moon, which is seen in partial eclipse photographs. About this time Mr. Edwin A. Stevens left the endowment, out of which grew Stevens Institute. Prof. Morton was appointed president of the institution in 1870, and he entered upon the task of making the institution the first school whose exclusive object was to teach mechanical engineering as a profession. In 1880 he presented the trustees with a $10,000 workshop. In 1878 he was appointed to the United States Lighthouse Board by Secretary Sherman. He also enjoyed the position of being a leading scientific expert in this vicinity. During the early days of his presidency he devoted much of his time to original researches, with results of considerable scientific importance. He took a deep interest in electrical matters, and was retained as an expert in connection with many of the famous litigations and controversies of the past 25 years. He was a wide contributor to American and foreign scientific publications, and was also the author of many poems, mostly humorous. The funeral exercises, which were largely attended, took place on Tuesday, May 13, at Trinity Episcopal Church, Hoboken, of which he was senior warden.

PERSONAL.

DR. CARY T. HUTCHINSON has moved from 71 Broadway to 56 Pine street, New York.

MR. ROBERT M'F. DOBLE, electrical engineer, etc., of San Francisco, has moved his offices to 314 Hayward Building in that city.

MESSRS. HOLTON AND REED, of the Manchester office of the British Thomson-Houston Company, Limited (controlled by the General Electric Company) are now visiting the United States.

MR. EDWARD F. SHELDON, for many years chief electrical engineer at the Hudson River State Hospital, at Poughkeepsie, N. Y., is now associated with M. F. L. Forest, electrical and mechanical engineer, Albany.

MR. A. L. RIKER, the pioneer inventor and engineer in the electric automobile and other fields, is reported to be perfecting a gasoline automobile for the Locomobile Company of America, hitherto known for its steam vehicles.

CAPT. G. O. SQUIER, of the U. S. Cableship "Burnside," who has been laying and repairing cable in the Philippines, writes that he is hopeful of reaching the United States some time this month, via Japan and Honolulu.

PREST. S. INSULL, of the Chicago Edison Co., with Messrs. Ferguson and Sargent, has been in New York City this week, with the object, it is said, of making contracts for a new plant. The Chicago lighting business is growing very rapidly.

MR. A. R. BLISS, treasurer and general manager of the New England Motor Company, of Lowell, Mass., has been in New York, and reports an excellent demand for the motors and generators of the company, new designs of which are being brought out.

MR. A. B. WEEKS has resigned his position as electrician with the Niagara Falls Power Company, to accept a position with the well-known Sherwin-Williams Company at Cleveland, Ohio. Mr. Weeks is well known to our readers as a contributor to these pages.

MR. R. M. BARWISE, who has had a good deal to do with the introduction of automobiles in this country, as the agent of different concerns, is now representing the Jandus and Buckeye Electric Companies in Philadelphia, with offices in the Real Estate Trust Building.

MR. M. R. HUTCHINSON, the electrical engineer, who has been devoting his time chiefly to the improvement of telephonic and microphonic apparatus for the deaf, sailed for England on the "Lucania" on Saturday. It is rumored that some important work awaits him on the other side.

MR. B. H. SCRANTON, president and general manager of the American Electric Heater Company, of Detroit, Mich., has been in the East lately. The concern is busily employed and is doing a variety of most interesting industrial work, possible only with the application of electric heat.

MR. DAVID SHANKS, of Handley & Shanks, electrical and general engineers, Birmingham, England, will be at the Waldorf-Astoria, New York City, on and after May 21, and would be glad while there to make appointments with manufacturers desirous of representation in Great Britain.

MR. GEORGE G. WARD, vice-president of the Commercial Cable Company, having but just returned from San Francisco, where he was busily engaged on preparatory work connected with laying the Commercial Pacific Cable, has now proceeded to England, sailing last Friday, with Mrs. Ward, on the "Celtic."

MR. GEORGE STANMORE, well known in electrical circles in New York City, has joined hands with a Mr. H. C. Wilson in starting the Steeplechase Hotel at Coney Island, on Surf avenue, near the famous Steeplechase Park. Mr. Stanmore proposes to pay special attention to automobile parties driving down to the Island.

MR. CHAS. EVELBAUER, representative of the Deutsche Waffen und Munitions Fabriken, who has been in Chicago making a thorough study of the Strowger automatic apparatus, manufactured by the Automatic Electric Company, has finished his work and leaves for Europe on May 15, to accept the position of manager of the telephone factory of the above-mentioned company.

MR. STEPHEN D. FIELD, the well-known electrical inventor and engineer, who has been engaged on electrical railway work for some years in Europe, with headquarters at Geneva, has just returned home, and is in residence at Stockbridge, accompanied by his wife and daughter. A great many old friends and admirers will meet him at the June Institute meeting at Great Barrington.

MR. A. S. LANGSDORF made an address on the evening of May 7, at the Engineers' Club, of St. Louis, Mo., on "Commercial Testing of Electrical Machinery." Mr. Langsdorf illustrated the tests made in factories of dynamos, motors, and transformers, with a view of obtaining a knowledge of the machines under a load before having them installed. The descriptions applied particularly to the tests made by the General Electric Company, at its plant in Schenectady, New York.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, accompanied by his wife, has sailed for Europe on the White Star Steamer "Celtic," for a tour of some months' duration. Dr. Wheeler has not only had a very busy year in connection with the company, but has given up a great deal of time and thought to affairs touching the proper care of the Latimer Clark library, which he gave so generously to the American Institute of Electrical Engineers.

MR. GEORGE F. PORTER, secretary of the National Electric Light Association, has, we regret to learn, found it imperative to hasten at once to the Pacific Coast in order to attend to work there in connection with the government Kerite cables now stretching to Alaska. He will thus be unable to attend the Cincinnati convention, but Past-president Cahoon has kindly volunteered his services in the emergency, and will at once take hold of affairs. Mr. Porter leaves immediately for the Pacific.

MR. CHARLES A. SPOFFORD, who has been connected with the Milwaukee Street Railway and several electric companies that are controlled by the North American Company, has been selected by Speyer & Co. to assist Mr. Yerkes in the management of the London underground railway system. He will take charge about June 1. The first work of the new company will be the electrical equipment of the subway system of the Metropolitan District Railway, which is now operated by steam.

MR. C. VANDEVENTER was tendered a farewell dinner recently by his office associates and friends at the Hotel Normandie, New York City. The occasion was Mr. Vandeventer's leaving the New York office of the Stanley Electric Mfg. Company to take the management of that company's Chicago office. Among those present were Dr. F. A. C. Perrine, president of the Stanley Company, Messrs. M. D. Barr, sales manager, John F. Kelly, consulting engineer, T. W. Kolman, J. G. Otis, B. J. Hough, C. E. Bibber, L. H. Hobbs, Ray D. Lillibridge, Ward Arnold and Z. V. Taylor.

MR. ALEX. HENDERSON, of the Sprague Electric Company, has kindly consented to act as master of transportation for the National Electric Light Association, in the absence of Mr. C. O. Baker, Jr., now in Europe. Mr. Henderson has been very busy during the past week meeting the wants as to transportation of those proposing to go by the special train on Sunday morning, and has taken all possible pains to circulate information and render everybody comfortable. His voluntary work at this juncture is very much appreciated by those who are going to Cincinnati to attend the Convention.

DR. F. A. C. PERRINE, president of the Stanley Electric Mfg. Company, on the evening of Friday, May 9, read a paper before the Boston Society of Arts at the Massachusetts Institute of Technology, on "Success in Long Distance Power Transmission." The special features of the paper were "the obstacles and difficulties met with in the engineering of the great transmission lines of California" and the details of their successful solving. On Saturday morning Dr. Perrine delivered an informal talk to the Senior Class in Electrical Engineering of the Massachusetts Institute of Technology, on "The Outlook in Electrical Engineering." The theme was the business prospects for young engineers. Dr. Perrine is to lead the discussion on "Protection of Long Distance Transmission Lines" at the Cincinnati convention next week.

MR. PAUL J. KRUESI, who for some time past has been connected with the management of the General Incandescent Arc Light Company, at their factory in New York City, has moved to Chattanooga, where he has become manager of the Sunlight Lava Manufacturing Company, a concern which is making electrical insulators and bushings, and lava work of every description. Chattanooga has become an active center in this branch of industry, and Mr. Kruesi's familiarity with electrical manufacture places him in a position of great advantage, as he is thoroughly conversant with the conditions which have to be met. It may be noted that this rising young manufacturer is a son of the late John Kruesi, of the General Electric works at Schenectady, long one of Mr. Edison's most intimate associates in the earlier days of the electrical arts.

MR. GEORGE A. DAMON, managing engineer of the Arnold Electric Power Station Company, of Chicago, was the guest of honor at a dinner of some of the younger graduates of the engineering courses of the University of Michigan, held at the Union Restaurant, Chicago, the evening of May 3. It is unnecessary to state in view of this event that Mr. Damon is one of the most popular engineers among the late graduates of his college to be found in Chicago, on account of his kindly interest in those just entering the profession. At the dinner he spoke on the subject of the engineer and the dollar, discussing whether the engineer should seek wealth or simply honor in his profession. Dr. Damon took the ground that there is no reason why an engineer should not seek both, and gave some figures on the income an engineer might expect to have at various stages in his career that were decidedly encouraging to the younger men.

MR. W. E. BAKER, until recently general superintendent of the Manhattan Railway Company, of New York, has decided to remain permanently in this city, and will now be associated with Mr. H. R. Bishop, Jr., under the firm name of W. E. Baker & Co., with offices at 170 Broadway. They will do a general electrical consulting and contracting business, but will be more closely associated with that branch which deals with electric railway engineering than any other. Mr. Baker's long experience in heavy electric railway work with the West End Railway Company, of Boston; the Intramural Railway at the World's Fair, at Chicago; the Metropolitan West Side Elevated Railroad, of Chicago, and the electrical equipment of the Manhattan Railway, in New York, places him in a prominent position in regard to this class of engineering. Mr. Bishop has been connected with the General Electric Company for a number of years and served as an officer in the 1st Regiment, U. S. V. Engineers, during the late Spanish-American war. He is the son of Heber R. Bishop, well known in financial circles.

Trade Notes.

THE COMMERCIAL ELECTRIC COMPANY, of Indianapolis, Ind., has increased its capital stock from $40,000 to $150,000.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, states regarding the "Howes" swiveling attachment plug, that its sales are rapidly increasing on this specialty.

C. W. HUNT COMPANY, of West New Brighton, S. I., have been calling special attention to their coal tubs for power plants of all kinds. They have been building such tubs for thirty years.

NEW AND SECOND HAND MACHINERY.—Wickes Brothers, Saginaw, Mich., have issued a monthly stock list of new and second-hand boilers, engines, machine tools, etc. The list is dated April 30.

ERRATUM.—The electrical ambulances at the new Lying-in-Hospital, New York City, described recently in these pages, are not equipped, as there stated, with Westinghouse motors, but with General Electric.

CONLEY ELECTRIC FURNACE.—We have an inquiry for the address of the Conley Electric Furnace Company, of New York, which controls the electric furnace recently patented and described in our issue of April 26.

FAN CATALOGUES.—Did you receive one of the new fan catalogues issued by the Electric Appliance Company, Chicago? This catalogue is complete and nicely gotten up and should be in the hands of every electrical buyer.

THE STANLEY ELECTRIC MFG. COMPANY has removed its New York offices to 29 Broadway, in order to acquire more room, which it could not obtain at the old place. The growth of the New York office force has been such as to render more room imperative.

CHAS. E. FELT & CO., 1156 Monadnock Block, Chicago, have recently opened an office for general electrical engineering; installations, power plants, etc., a field in which they have had fourteen years' experience. Mr. D. Avery Kimbark, consulting electrician, is associated with the concern.

GLAZE-FILLED INSULATORS.—The R. Thomas & Sons Company, East Liverpool, Ohio, has issued a booklet on Boch glaze-filled high tension insulators, giving general data on their construction, etc., as well as a review of patent litigation undertaken by the company to sustain its patents on these insulators.

MESSRS. HUBBARD, HALL & COMPANY, 213 West Fourth street, Cincinnati, Ohio, are sending out several leaflets describing and illustrating various electrical and other supplies and specialties handled by this firm. These include Columbia incandescent lamps, electric light guards, pay-out reels, etc.

STEAM HAMMERS.—Bement, Niles & Company, Philadelphia, Pa., have issued a handsome catalogue of their extensive line of steam hammers. These machines are very thoroughly described as to their construction and use, and illustrated by artistic halftone cuts, which show the different sizes and designs.

THE NEW ENGLAND MOTOR COMPANY reports brisk business for some time past. In order to meet the demand for its product, it is had to run its factory on overtime during the major part of the last six months. Among recent orders which it has booked are one of twenty 2-hp. motors to go to Chicago, and six special 50-hp. size 6-pole machines for the U. S. Navy.

THE ACME TIME SWITCH, manufactured by the Acme Switch Company, 458 Asylum street, Hartford, Ct., is described and illustrated in a pamphlet just issued by the company. This switch is designed to automatically control electric lighting current, and that it is satisfactorily fulfilling this purpose is evident from the large number in use by the principal central stations throughout the country. It is stated to be accurate, and it always acts on time.

JANDUS ELECTRIC FAN.—The Jandus Electric Company, 115 Broadway, New York, has issued a pamphlet describing its line of fans for the season of 1902. This type of fan is made for alternating and direct currents, and combines on one a desk fan, bracket fan, trunnion fan, and bracket-trunnion fan. All of the advantages of this useful machine are pointed out in clear language, and illustrations show its construction, compactness being one of the principal features.

O. K. SPECIALTY MFG. COMPANY, Garrettsville, Ohio, is placing on the market a line of specialties, including knife switches, time switches, tablet boards, terminal logs, enclosed fuse cut outs, plug cut outs, etc., all built to meet the underwriters' rules. These goods are understood to be meeting the needs of users, and the approval of electrical supply houses, lighting plants, etc. The company will be glad to receive inquiries with regard to its apparatus from reliable houses.

RIVETING MACHINE.—Mr. John T. Allen, 370 Gerard avenue, New York City, who manufactures a complete line of portable pneumatic riveting machines, pneumatic drilling machines, tool holders, etc., has just received an order from the Canadian General Electric Company for two jaw riveters having a 36-in. reach, 20-in. gap and 12-in. cylinder, capable of driving 1¼-in. rivets. Four of Mr. Allen's machines have been installed in the new plant of the Westinghouse Company, at Manchester, England.

PASS & SEYMOUR.—The Cincinnati office of Pass & Seymour, Inc., has been removed from 405 Union Trust Building to more suitable and commodious quarters at 234 West Fourth Street, Cincinnati, Ohio, where a full line and complete stock of P. & S. specialties are carried. A cordial invitation is extended to those attending the National Electric Light Association's Convention, to be held at the Grand Hotel, on May 20, 21 and 22, to visit the new quarters and make the office their headquarters during the convention.

INSULATING COMPOUNDS.—The Mica Insulator Company, 218 Water street, New York, is making a M. I. C. compound of black enamel, in four grades to suit all requirements. It is composed chiefly of linseed oil, Cuban asphaltum, and Para rubber, and is well adapted for coating armature coils, field magnets, electric wires, cables, arc lamps, etc. Reports of tests of these compounds are given in a pamphlet just issued by the company, which includes a sample of the compound applied to fabric. Several of the principal electric railway and electric light companies throughout the country are consumers of M. I. C. compound, a list of these concerns being given in the pamphlet, together with much other information on the general subject.

I. P. FRINK, New York, whose name and fame in the successful installation of all kinds of lighting fixtures, circulates around the globe, reports among recent export orders the shipment of large church reflectors to Brazil, Chatham, N. B., and Vancouver, B. C., Canada, Manila, Philippines, Moravian Mission, Bluefields, Nicaragua, C. A.; window reflectors to Birmingham, England, and to Mexico City, Mexico; and a general order for shades, special cluster reflectors, and window reflector to Cape Town, Africa. Mr. Frink carries a large line of electrical and other lighting specialties that might be profitably taken up and pushed in export fields, and any one interested in that direction will find much valuable data in the very complete catalogues which this firm sends out.

CROUSE-HINDS ELECTRIC COMPANY has removed from Union Trust Building to 234 West Fourth street, Cincinnati, where a new store is being opened. Owing to the constant increase in business, the former quarters have for some time been too small. The new quarters will be made a distributing point for Ohio, Southern Indiana, Kentucky, Tennessee, Mississippi and Alabama, which territory will be under this office, and a large stock of switches, panel boards, and "Syracuse" head lights will be carried in stock. The new store will be in charge of Mr. Charles M. Crofoot, the former manager, who will be assisted by a competent office force. Convention visitors will be welcome, and are invited to have their mail sent in "Crouse-Hinds'" care. A stenographer will be furnished anyone desiring the use of one.

THE NUNGESSER ELECTRIC BATTERY COMPANY of Cleveland, Ohio, has just commenced operations in its new factory building, which gives it nearly three times the capacity of the old plant. The new factory is 160x160 feet, and two stories high, being located on King street, facing the L. S. & M. S. Ry. tracks, giving the best of shipping facilities. A large amount of special machinery is being installed and within thirty days the factory will be running at full force, with a capacity of 250,000 cells per month. These figures give some idea of the enormous demand for these batteries, which are used very largely in telephone work. Heretofore the company has been wholly unable to take care of all orders offered, but with the increased facilities it will be enabled to handle almost any amount of business. The capital stock of the company is to be increased at the May meeting.

KELLOGG CATALOGUE.—The Kellogg Switchboard & Supply Company, Chicago, Ill., has just issued a general descriptive catalogue of its apparatus. In this catalogue is given much information concerning its line of telephone instruments, switchboards, and other apparatus, all of which are illustrated. At the back is a code list for use in connection with the cuts, and which gives a brief of the salient features, not only of the particular pieces of apparatus illustrated, but of its various modifications. Besides the illustrations of the many styles of apparatus manufactured by the Kellogg Company, are others showing the different departments of the company's factory, and of several important independent exchanges throughout the country equipped with Kellogg apparatus. Part of the catalogue is devoted to switchboards of all classes, which are very attractively illustrated. The line of these devices is a surprisingly extensive one. Every telephone manager will find much of interest to him in the contents of this catalogue.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 6, 1902.

(Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau-st., N. Y.)

11,983. RAILWAY SIGNALING AND SWITCHING APPARATUS; J. D. Taylor, Buffalo, N. Y. App. filed June 7, 1898. An interlocking or controlling apparatus having means for preventing a lever changing its position in either direction before the track switch has made its complete movement.

699,140. ELECTRICAL ANNUNCIATOR; C. C. Blake, Brookline, Mass. App. filed Sept. 26, 1901. An electric magnet whose armature is adapted to operate a target in a colored fluid toward and from a transparent window, to be visible when in proximity to the window, and be concealed by the colored fluid when away from the window.

699,146. ELECTRIC COMBUSTION FURNACE; W. M. Carr, East St. Louis, Ill. App. filed March 3, 1902. (See Page 868.)

699,158. WIRELESS TELEGRAPH SYSTEM; C. D. Ehret, Washington, D. C. App. filed Dec. 3, 1901. Comprises a wireless telegraph receiver which is operated by the simultaneous reception of electromagnetic waves of different frequencies, the waves of different frequencies operating upon dissimilar wave-responsive devices, such devices being in local circuits by which are produced the signals.

699,162. TELEPHONE CIRCUIT SYSTEM; E. F. Frost, Washington, D. C. App. filed Nov. 13, 1900. (See Page 866.)

699,177. ELECTRIC CALL SYSTEM; F. E. Huggins, Zeandale, Kansas. App. filed Apr. 12, 1901. Details.

699,181. JUNCTION OR FUSE BOX; M. H. Johnson, Utica, N. Y. App. filed Dec. 28, 1901. A removable tablet on which the electrical devices are mounted, is placed in a box in a manner permitting of ready access to the parts.

699,187. MEANS FOR CONNECTING DYNAMOS WITH TRUCKS OF RAILWAY CARS; P. Kennedy, Brooklyn, N. Y. App. filed Aug. 17, 1901. The dynamo is mounted in an overhanging frame from the truck, the supports running parallel to the belt which connects the dynamo pulley with the axle pulley.

699,193. DEVICE FOR CLEANING AND RUBBING COLLECTORS OF ELECTRIC MOTORS AND DYNAMO MACHINES; W. Kuppers, Berlin, Germany. App. filed Feb. 11, 1902. A block having a curved rubbing face conforming to the surface of the commutator and having a cavity into which the metallic particles are carried when ground off.

699,196. ELECTRIC ARC LAMP; A. Lees, New Bedford, Mass. App. filed Dec. 6, 1900. The lower carbon holder is supported by the wire net which protects the globe and current is carried through the net to the holder.

699,202. ELECTRIC GAS LIGHTER; A. J. Marschall, Little Falls, N. Y. App. filed Mar. 8, 1901. A battery casing and stem leading therefrom, at the end of which is a filament to be heated by the current for igniting gas.

699,205. ELECTRICAL TAP SOCKET; E. B. Meyrowitz, New York, N. Y. App. filed Aug. 27, 1901. A switch block is fixed transversely in the socket and is adapted to be forced inward on either side to project from the other side; the terminals of a branch circuit can be connected with either end of the block to place it in series or parallel with the main circuit when the connected end is forced inward.

699,208. VACUUM TUBE SIGN; D. M. Moore, Newark, N. J. App. filed Apr. 13, 1901. The improvements relate to an exciter to be used in connection with the tubular letters forming the sign.

699,215. ELECTRICAL OUTLET BOX; E. W. Muller, Brooklyn, N. Y. App. filed Mar. 11, 1902. An electrical outlet box having a receptacle-carrying part adjustable on the body of the box so as to shift the center of the receptacle.

699,218. ELECTRIC SWITCH OPERATING DEVICE; A. J. McCullough, Meadville, Pa. App. filed Mar. 29, 1901. The core of a solenoid is connected through a chain directly with the switch point, a spring serving to return the point after it has been moved by the solenoid.

699,225. ELECTRIC ARC LAMP; J. S. Nowotny, Madisonville, O. App. filed Mar. 19, 1896. Relates more particularly to the shape of the carbons, they being parallel throughout the portions which are to burn and offset from each other to accommodate the carbon holders above those portions.

699,232. METHOD OF TREATING BALLAST WIRES FOR ELECTRIC LAMPS; H. N. Potter, Pittsburg, Pa. App. filed July 14, 1900. To provide a ballast device, the temperature of which will increase uniformly throughout its length under the action of an electric current, the ballast is heated in the presence of a compound containing the material of which the ballast is composed, the temperature being raised to a point where a deposit of the said material will be made upon the ballast.

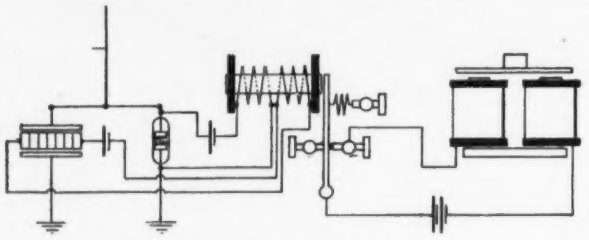
699,275. AUTOMATIC ANNUNCIATOR; J. A. Wotton, Atlanta, Ga. App. filed June 10, 1901. A solenoid provided with a divided core, one part being longer than the other, the shorter part connected with the resetting mechanism and the longer part adapted by its momentum when moved in the coil to actuate the shorter part to reset the annunciator.

699,294. APPARATUS FOR AERATING OR AGITATING LIQUIDS; Harold E. Dolphin, Cressington, near Liverpool, Eng. App. filed Jan. 17, 1902. An arrangement whereby a jet of water leading to a tank becomes commingled with air, the water and air together setting up a considerable agitation in the tank. In one arrangement a number of tanks have but one outlet for the overflow water, the surplus passing in sequence from one tank to another up to the final tank.

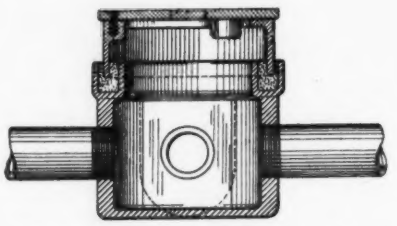
699,333. VESSEL FOR THE RECEPTION OF HIGH PRESSURE GASES; Albert Ludwig, Bernburg, Germany. App. filed Oct. 3, 1900. A gas-tight closing device for vessels or metals containing gases under high pressure, such for example as are used for the production of artificial diamonds.

699,364. TROLLEY STAND; C. G. Bleasdale, Detroit, Mich. App. filed Aug. 14, 1901. The rotative support of the trolley stand is inclosed by a suitable housing.

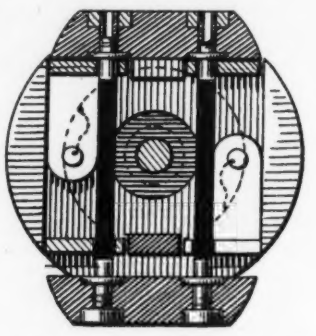
699,381. OUTLET BOX FOR ELECTRIC WIRES AND CONDUITS; J. M. G. Fullman, Pittsburg, Pa. App. filed May 16, 1901. A water-tight floor outlet box comprising a stationary box and a cap for the same adapted to be adjusted vertically with reference to the floor level, so as to be brought flush with the floor regardless of whether the box itself is accurately placed or not.



699,158. Wireless Telegraph System.



699,381. Outlet Box for Electric Wires and Conduits.



699,205. Electrical Tap Socket.

699,383. INSULATING COMPOSITION AND METHOD OF PRODUCING SAME; A. Gentzsch, Vienna, Austria-Hungary. App. filed Aug. 30, 1901. An insulating composition consisting of gum rubber or caoutchouc and a vegetable wax kneaded together under a mild heat which is increased gradually during the kneading operation.

699,388. DYNAMO; S. Hutchins, Manchester, Eng. App. filed Dec. 19, 1901. A field magnet movably mounted and adapted to follow the armature and means for maintaining a constar. difference of speed between the armature and the field magnet.

699,412. DEVICE FOR OPERATING ELECTRIC LIGHTS IN RAILWAY CARRIAGES FROM THE GUARD'S VAN; E. J. Preston, Beckenham, and A. B. Gill, Blackheath Park, England. App. filed Dec. 8, 1899. A hand and automatic switching apparatus so arranged that by moving the hand switch once, various groups of lights on the car will be successively cut in and out.

699,413. STORAGE BATTERY; Jerome Redding, Boston, Mass. App. filed Aug. 5, 1901. Alternate indentations and protuberances are produced in sheets of lead foil by means of punching, the foil being practically reduced to a state of fine mesh. Strips of the foil are then coated with red lead or litharge, superposed and united in frames so as to form battery elements.

699,414. METHOD OF TREATING SOLUTIONS OF SALTS; C. J. Reed, Philadelphia, Pa. App. filed Aug. 1, 1901. (See Page 868.)

699,415. ELECTROLYTIC APPARATUS; C. J. Reed, Philadelphia, Pa. App. filed Aug. 1, 1901. (See Page 868.)

699,455. COMBINED HOSE AND ELECTRIC SIGNALING DEVICE; H. T. Cronk, New York, N. Y. App. filed Mar. 5, 1901. A hose having two wires embedded therein out of contact with each other, and contact-plates arranged on the inside and outside respectively of the hose and each connected with one of the said wires.

699,469. ELECTRIC COUPLING; T. C. James, Manistee, Mich. App. filed Aug. 28, 1901. An electric coupling comprising two sections, each divided into two chambers, contact devices arranged in the chambers, and contact devices carried by each section for closing a circuit when the sections of the coupling are separated.

699,483. ELECTRICAL APPARATUS; T. H. Brady, New Britain, Conn. App. filed July 20, 1901. When the meter is taken out, a sealed box is left in its place into which the ends of the conductors are passed and held to prevent tampering therewith.

699,492. PROCESS OF FORMING STORAGE BATTERY PLATES; Rufus N. Chamberlain, Depew, N. Y. App. filed Mar. 3, 1899. The plates are pickled, constituting the same as anodes in an electrolytic bath containing a pickling agent such as solution of nitric acid, and collecting on a cathode the lead which has been dissolved by the pickling solution. From the pickling bath the plates are removed to the forming bath, each plate being first the anode in such bath and receiving a coating of oxide, then being constituted the cathode in the same or similar bath, a fresh plate being then made the anode. The reduction of the oxidized coating on the first plate thus serving to diminish the amount of energy required to form a coating of oxide on the second plate. The electrolyte used for the forming plates is a dilute solution of acetic and sulphuric acids in water.

699,493. METHOD OF CLEANING SPONGY LEAD PLATES FOR STORAGE BATTERIES; R. N. Chamberlain, Depew, N. Y. App. filed Mar. 3, 1899. The process of cleansing a spongy lead plate from the active dissolving agent of an electrochemical forming-bath which consists in exposing said plate as a cathode in an electrolytic bath, such bath containing a solution relatively free from such active agent.

699,506. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, O. App. filed Dec. 28, 1901. Parallel plates carrying the fixed contacts on their outer faces are embraced by a U-shaped arm which is pivoted and carries the brushes on its respective legs which engage with the respective contacts.

699,566. AUTOMATIC STARTER FOR ELECTRIC MOTORS; J. E. Putnam, Rochester, N. Y. App. filed Sept. 8, 1900. The starting resistance is cut out by a centrifugal device driven by the motor.

699,574. TELEGRAPHIC DISTRIBUTION; H. A. Rowland, Baltimore, Md. App. filed July 24, 1901. A claim defines the invention as follows: The combination with two or more telegraph lines, of a repeating station located upon said lines and comprising the following elements, viz., a source of electricity from which said lines receive current, main line transmitting and receiving instruments, local transmitting and receiving current distributers operating in conjunction with said main line instruments and local circuit making and breaking devices operated by the receiving instruments of one line and automatically operating the transmitting instruments of another line.

699,575. TELEGRAPHIC PAGE PRINTER; H. A. Rowland, Baltimore, Md. App. filed July 24, 1901. The invention has reference especially to improvements upon the carriage shifting mechanism described in another application by this patentee.

699,582. SIGNAL APPARATUS; S. C. Shaffner, Mobile, Ala. App. filed Jan. 9, 1902. The street lighting system is combined with the telephone police signal system by means of certain switching apparatus, so that a policeman on beat can be signaled from the central office by sending a current over the telephone line which will operate a switch in a particular signal box to flash a light on the lighting circuit.

699,583. MEANS FOR AUTOMATIC CONTROL OF MOTOR VEHICLES; H. H. Sherk, Pasadena, Cal. App. filed Nov. 5, 1901. A plunger is operated by a movable seat to turn on the power when the seat is occupied, the invention relating more particularly to devices for regulating the action of the plunger to accomplish various functions.

699,590. ELECTRIC RAILWAY; A. A. Stolle, New York, N. Y. App. filed Oct. 22, 1901. Instead of running over crossings with the power turned off, the usual gap in the conductor at the crossing is automatically closed by the car, thus permitting the car to pass over under power.

699,618. RAIL BOND; A. H. Englund, Philadelphia, Pa. App. filed Mar. 3, 1902. A rail bond consisting of two heads united by a body formed in two divisions of unequal transverse dimensions, the purpose being to distribute the portions with respect to the spaces available between the fish plates and rail and still obtain the greatest carrying capacity.

699,619. COMBINATION DROP AND JACK FOR TELEPHONE SWITCHBOARDS; Henry M. Fisk, Wheaton, Ill. App. filed June 22, 1900.

699,630. METHOD OF RECORDING MESSAGES, SIGNALS, ETC.; P. O. Pedersen, Copenhagen, Denmark. App. filed Mar. 9, 1900. (See Page 866.)

699,633. ELECTRIC CUT-OFF SWITCH; L. W. Richardson, Dustin, Tenn. App. filed Oct. 10, 1901. A switch adapted to readily cut off a subscriber's telephone from the main wire during electric storms.